

Proposal for the Gathering of Data and Survey Method on Local Residents' Knowledge of Freshwater Fish Spawning in the Middle Mun River Basin, Thailand

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1. Introduction

The Mun River

The Mun River flows through northeastern Thailand and is one of the main tributaries of the Mekong River, which has the largest watershed area in Thailand. The Mun River rises in the mountainous region of Nakhorn Ratchasima Province, passing through Buriram, Surin,, Sisaket Provinces to flow into the Mekong in Ubon Ratchatani Province. For approximately 30 km upstream from the confluence with the Mekong River, the Mun river has a complex riverbed consisting of successive rapids and



pools. The middle basin also has flooded forests, known as *paabung paathaam* (ป่าทุ่งน้ำท่วม), which become inundated in the rainy season, and extensive areas of marshes and oxbow lakes, remnants of former river channels, which connect with the river as the water level rises. This complex environment, suited to the survival of fish, has nurtured as many as 270 species of fish (ICEM 2010).

In the lower Mekong River basin (south of the border between China and Laos PDR) there are distinct dry and rainy seasons due to the monsoon, causing the water level of the river to show large fluctuations. As the water level falls and water clarity is high in the dry season, light penetrates to the riverbed, bringing about an environment suited to habitation by fish that thrive on algae.

It is also reported that the forests, which are inundated by rising waters in the rainy season, provide a suitable environment for the breeding of fish species and the growth of young fish (Ternvidchakorn and Horle 2013).



Tana Rapids at the mouth of the Mun River



Paabung paathaam

Mekong River Basin Fish and their Migration

The habitats of fish change with each stage in their life history. For example, the Japanese sweetfish (*ayu*, *Plecoglossus altivelis*), which has high commercial value, spawns in freshwater, but the fry swim downstream, carried along by the flow of the river, after hatching from the eggs. After growing in the sea, the young sweetfish return to swim upstream and inhabit the upper and middle river basin, moving to the lower basin at spawning time. Thus, stages in the growth of fish are associated with specific locations.

There are also several definitions of fish migration, but here we will refer to “migration” as the movement of fish to a specific location in the same period each year for spawning or for food, regardless of the distances involved in the movement.

Taking an overall view of the lower Mekong basin, it is reported that, roughly speaking, movements of fish are seen as (1) movements upstream and downstream in the mainstream of the upper Mekong, (2) movements between the mainstream and tributaries in the areas around the Thai-Lao border, and (3) movements between the Mekong mainstream and areas around Tonle Sap Lake, the Mekong delta flood plain, and tributaries (MRC 2002). See Figure 1.

The “triggers” for this fish migration are changes in water level in the lower Mekong basin and water turbidity at the beginning of the rainy season (Baran 2006).

In the Mun River, the movements of fish occurred between the Mun River and the Mekong mainstream throughout almost the whole year, with the exception of January, the peaks being in the two fish runs of February/March and May/June. In the February/March period, small *Cyprinidae*, fish of the carp family, known locally as *Pa Soy* and *Pa Taep*, and loach-like fish (*Botia* spp) such as *Pa Muu* and *Pa Kiyao Kai* move into the Mun River, and in the May/June period, all the other migratory fish, mainly catfish-like species, swim up the river. Many of the fish descend from the Mun River to the Mekong in the October/November period (AOP and SEARIN 2002b, Mekong Watch 2004).

Data on the spawning of Mekong River fish

Ternvidchakorn and Horle (2013) gathered data on the fry of 64 fish species from the

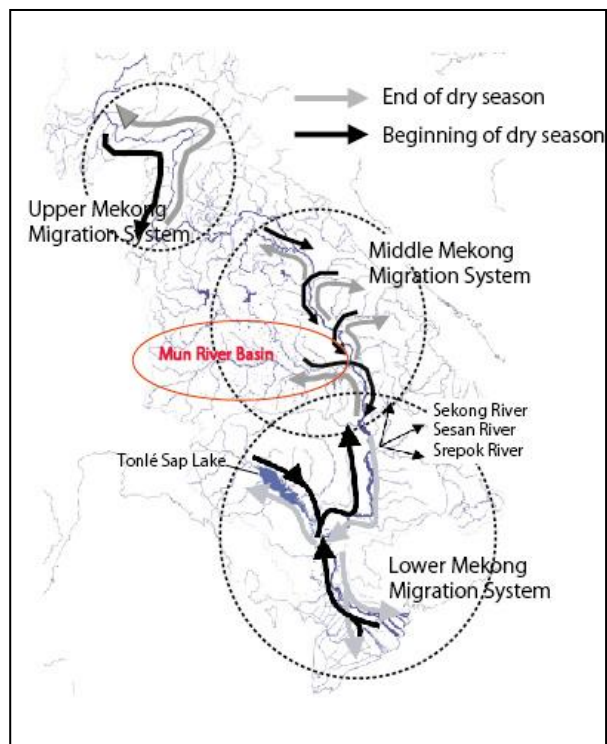


Figure 1. Prepared from materials by the Mekong River Commission

existing literature. Mekong River fish species have been seen to broadcast their eggs in the water, lay them onto objects such as submerged fallen logs, or guard the eggs where they have laid them. This report, however, does not give specific details on spawning grounds.

Otsuka (2007) conducted a detailed fry sampling survey on the Xe Chan Phon River, a tributary of a tributary of the Mekong River in Lao PDR. Fish are seen to breed during the rainy season in rivers in the lowland areas of the Mekong River, and especially the fish that inhabit the rivers breed in the temporarily inundated areas, taking their timing from the rise in water level in the rainy season. When the water floods over the natural banks of the rivers in the middle stage of the rainy season, the fish move into the flood plain and then move back into the mainstream of the rivers at the end of the rainy season. This survey clarified the fact that fish use not only the river but also the surrounding environment as an integrated environmental set (Otsuka 2007).

Roberts and Warren (1994) have reported that the spawning grounds for *Probarbus* sp. are upstream from the Khone Falls in Laos PDR, but did not give precise details of matters such as spawning behavior (Roberts and Warren 1994).

Importance of the Mun River in the ecosystem of the Mekong River fish species

It is thought that at least 1,100 fish species inhabit the Mekong River, and of these 270 species have been confirmed in the Mun River (ICEM 2010). In accordance with the classification of the residents of the lower Mun River basin, 129 species of fish have been confirmed in the Mun River, of which 103 species migrate to and from the Mekong River mainstream (AOP and SEARIN 2002). Among the fish that swim upstream, several species are carrying eggs, and it is known from observations by fishing people that large numbers of small fish descend into the Mekong River during the October/November period (interview with local residents). This suggests that Mekong River basin fish that migrate into the Mun River spawn there and return to the Mekong when they have grown to some extent. That is, the Mun River is the spawning ground and the habitat for the growth of the fry.

A team from Ubon Ratchathani University has confirmed 184 fish species in the lower Mun River basin (Ubon Ratchathani University 2002). It is also known by local residents that fish spawning behavior can be seen in wetlands of the middle Mun River basin (Research Committee of the Villagers of Rasi Salai. 2004).

It may also be inferred that fishery resources were abundant in the lower Mun River basin from the fact that there were a large number of households that placed inland fishery at the center of their livelihoods before the construction of the dam there (Ubon Ratchathani University 2002).

Dam construction in the Mun River and changes in its operation

The irrigation dam, the Rasi Salai Dam, constructed in the middle Mun River basin, began to store water in 1993, permanently inundating a vast area of wetlands. The Pak Mun Dam, a hydropower dam constructed at the confluence of the Mun and Mekong Rivers, began operation in 1994, obstructing the migration of fish to and from the Mekong River. It is believed that the obstruction of the migration of fish in the lower basin and the loss of habitat in both the middle and lower basins resulted in the steep

decline of natural fish in the Mun River.

Fish passes were built into the Pak Mun Dam, but almost completely failed to function correctly (WCD 2000).

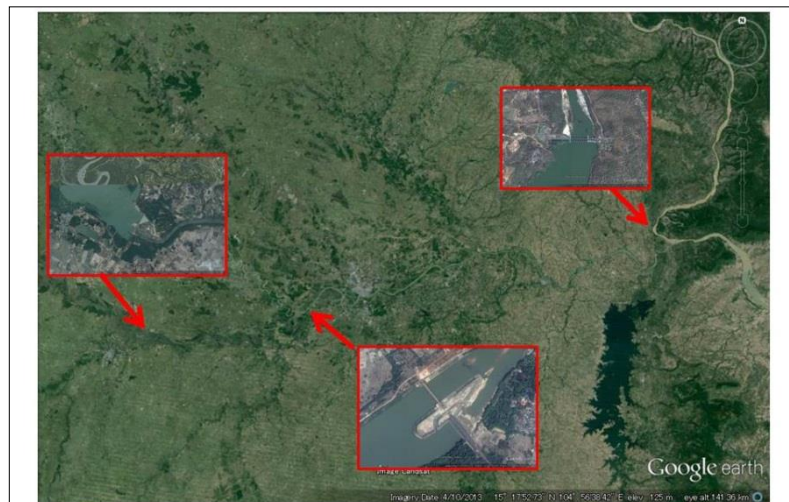


Pak Mun Dam



Rasi Salai Dam

The decline in fishery resources and the loss of livelihood opportunities from the use of the wetlands by the local residents led to impoverishment of the local people, who demanded compensation at the time. However, the compensation was not sufficient to recover their livelihoods, and wishing to return to



Locations of the three dams (right to left: the Pak Mun, Hua Na and Rasi Salai

their former livelihoods that made use of the river resources, the local people began a resistance movement to appeal for the dams to be abandoned. The local people's appeal resulted in a reassessment of the environmental and social impacts of the dams as well as surveys, widely supported by Thai academics, being conducted on the knowledge of the natural surroundings and their use by the local residents themselves (AOP and SEARIN 2002b). Moreover, a study by Ubon Ratchatani University, commissioned by the Thai government, proposed the opening of the water gate of the Pak Mun Dam throughout the year for five years in order to allow the ecosystem to recover (Ubon Ratchathani University. 2001). Measures such as a decision to provide supplementary compensation to local residents at Rasi Salai Dam were also taken. However, the Thai government did not agree to the opening of the water gate, and as a compromise proposal the Electricity Generating Authority of Thailand (EGAT), the operator of the Pak Mun Dam, was instructed to open the water gate for four months each year and a

similar mode of operation has also been carried out at the Royal Thai Irrigation Department's Rasi Salai Dam.

In 2014, the Hua Na Dam was completed midway between the Pak Mun Dam and the Rasi Salai Dam, and thus there are now three dams in the mainstream of the Mun River between the wetlands in the middle Mun River basin and the confluence with the Mekong River.

Current state of Mekong River basin dam development

Dam development is continuing in the Mekong River basin as a whole. At least four mainstream dams are in operation upstream in China, and in Laos PDR, construction of the mainstream Sayaburi Dam is underway. Also in Laos PDR, the Nam Theun 2 Dam is giving rise to impacts on the Mekong tributaries the Nam Theun and Xe Bang Fai Rivers. In addition, there are also several dams being constructed on Lao tributaries, in the Ou River basin in the north, financed by Chinese funds/companies, and in the Sekong River basin in the south by Vietnamese capital. On the three rivers, the Sekong, Sesan and Srepok Rivers, which flow through Vietnam, Laos PDR and Cambodia, and which form the largest group of tributaries to the Mekong River, several dams are under construction not only in upstream Laos PDR but also in Vietnam. Moreover, in the area of the Sesan River at the confluence of the Srepok and Sesan Rivers, the construction of the Lower Sesan 2 Dam has also begun. If this dam is completed, it is forecast that fish catches in the lower Mekong basin will decline by 9.3% (Ziv 2010), indicating that this dam will have a very great impact on the riverine ecosystem.

Impacts on fish caused by the Pak Mun Dam and Rasi Salai Dam

In general, dams not only obstruct the movements of fish at every stage of the life history of fish, but also bring about changes in water level and water flow of fish habitats, affecting feeding and spawning behaviors.

It has been reported in North America that dams alter water and sediment flow volumes, have impacts on riverbeds, and especially affect the spawning of salmon and other fish (Kondolf 1997).

Water storage behind dams also alters the water level, water temperature and vegetation of spawning grounds, and there is concern that this may lead to spawning ground reduction. The Mekong River basin has a great abundance of highly migratory fish, and the fact itself that dams obstruct the movements of these fish is a crucial issue. From these reports, we may estimate that the impacts of the Pak Mun Dam and Rasi Salai Dam are as given in the following five points.

1. Following the beginning of operation of the Pak Mun Dam, the movement of fish swimming upstream to their spawning grounds was obstructed, and there is the possibility that, being unable to enter the Mun River, these fish lost opportunities to reproduce. It is possible that this has led to the decline in the amounts of fish resources in the Mekong River.

2. In the Mekong River basin, changes in water level act as the trigger for migration,

but the water level varies both upstream and downstream due to the storage and release of water by dams, and this may have impacts on fish ecology. Especially at the Pak Mun Dam, water is released to generate electricity, causing water level rises that bear no relation to the natural water level rises of the rainy season, and it is possible that this has impacts on the migratory behavior of fish downstream.

3. From previous research, it is thought that since there is little intrusion of large fish into shallow areas of rivers, such as areas close to river banks and rapids, these areas are important for fish growth because fish fry and young fish are able to evade predators. However, shallow areas in rivers have been reduced due to river bank erosion at the times of water releases and water storage behind dams, thus reducing habitat areas for young fish. This may be causing impacts on the life history of many fish and the amounts of fish resources.

4. Due to the water storage of both dams, there is no lowering of the water level upstream from the dams, making the growth of algae difficult because light no longer penetrates to the riverbed. The water level changes due to the dams may also be having impacts on fish food and habitats caused by alterations in riverine vegetation.

5. A part of the flooded forests in the middle Mun River basin have been permanently inundated due to water storage behind the Rasi Salai Dam, causing indigenous plant species to die off, profoundly altering the local vegetation. It is possible that this is having impacts on the ecology of fish for the part of their life history when they make use of the trees that are inundated during the rainy season.

2. Problem Awareness of this Survey

The Mekong River basin boasts the world's second greatest fish diversity after the Amazon River, but is now facing a serious crisis. The fish habitats in the lower Mekong River basin must be thought of as an integrated environmental set consisting of the mainstream, the tributaries and the lakes and marches that are connected to them in the rainy season. In the 1990s, with the exception of the Thai tributaries, the Mekong passed from a state where almost no dams existed to one in which several mainstream dams were constructed on the river inside China, and then to the present, where roughly 60 dams, some of which will be in the mainstream, are scheduled for construction. Moreover, with the development of roads and irrigation channels, rivers, former rivers and flooded forests are no longer connected, and the river environment has been decoupled from the river itself. The cold chain has developed along with the upgrading of the electric power grid, and as it has become possible to transport fish longer distances, the pressure on fisheries has increased. The degradation of water quality has also proceeded along with urbanization and the increase in tourism. Factors threatening the survival of Mekong River basin fish are continuing to increase in number.

At the same time, natural fish are a cheap and important source of protein for the

residents of rural areas. Fishing is also a means of gaining cash income that can be realized with very little capital investment. For the rural residents of the Mekong River basin, the continued use of fishery resources is an urgent issue.

The Hua Na Dam has been completed as the third dam in the mainstream of the middle and lower Mun River basin, but this dam has no fish pass or any other function that takes fish ecology into consideration. Unless the Hua Na Dam is operated with some period when the water gate is opened, as with the Pak Mun Dam, it is forecast that in the future there will be almost no movement of fish between the middle Mun River basin and the Mekong River.

Up until now, the residents of northeastern Thailand have lived with the blessings of abundant natural resources. It is reported that as recently as 40 years ago a village might migrate when useful resources close to the village were depleted. The depletion of natural resources due to overuse was therefore not a factor that threatened the lives of the people. At present, however, the population has increased and productive land has become limited due to a variety of development projects, and as the registration of land has become stricter, it has become impossible to move in the way that people were able to do formerly. Because of this, local residents in many villages, concerned about the reduction in fish resources, have established fishing bans in pools nearby the village to prevent “overfishing” in the dry season. Further in order to create locations where no killing takes place, conservation influenced by Buddhism is being carried out in the form of fishery conservation zones or no-fishing zones in pools in front of riverside temples. Some of these are receiving support from the local administrations. However, since the life histories of many fish are not yet well understood, there is concern that the current conservation zones do not include environments that make possible the reproduction of fish.

There are few researchers in Thailand who are conducting research into natural fish. Relevant agencies such as the Thai Department of Fisheries have a strong interest in aquaculture developments, but knowledge concerning the conservation of natural fish is overwhelmingly scarce. In the present situation, those that are observing fish the most, and that have the greatest amount of accumulated knowledge about fish, are the local people who are practicing fishing as part of their daily livelihood. At present, however, there have been few studies carried out to document this knowledge.

3. Purpose and Method of the Survey

3.1 Purpose of the Survey

We aim to build a basic database, based on the knowledge of the local residents, in such a way that fish conservation zones encompass spawning grounds and locations for the growth of fish in the Mun River, one of the important tributaries of the Mekong River, and a river in which dam development proceeded ahead of that in Laos PDR and Cambodia.

For this purpose, we will, together with local residents, collect and summarize the knowledge of local residents on the spawning of existing natural fish and their young

fish nursery grounds. Based on this survey, we will also propose a simple survey method that can be implemented by local residents to discover environments that should be conserved in each village in order to establish fish conservation zones that are scheduled to be set up in each village in the middle Mun River basin in the future.

3.2 Survey Items and Survey Method

- A literature review on rivers and their surrounding environments that are used by fish
- In order to clarify fish spawning behaviors and spawning grounds in the middle Mun River basin after the construction of the Rasi Salai Dam, semi-structured interviews, in which the interviewer fills out a question sheet during interviews, will be conducted with local residents engaged in fishing in the middle Mun River basin.

4. Survey Results

The literature review and local interview survey are summarized below.

4.1 Understanding the geographical features of the middle Mun River basin, the target area of the survey, through the literature review

In the middle Mun River basin, the river mainstream and the former river course are intricately interwoven over an extensive area covered by a complex environment of wetlands and flooded forests. These areas are distributed across the three provinces of Surin, Roiet and Sisaket. Local residents term this environment “*paabung paathaam* (ป่าบุงป่าท่าม)”.

The first Thai researcher to study the topography of *paabung paathaam* describes it academically as follows: “*Paabung paathaam* refers to a type of wetland that occurs over an extensive area of lowland near a river that is inundated for several months each year when the river overflows its natural levees in the rainy season or at times of flooding. As fertile soil flows in from the river, plants grow luxuriantly and gather together in the ‘bung’ and ‘thaam’ environment to create an abundance of wildlife and food.” (Sansanee Chuweo, 1995. Report of the Social Research Institute, Chulalongkorn University)

In another report by the Social Research Institute, Chulalongkorn University (2009), the main topological features of the middle Mun River basin are classified as follows.

***Kut* (กุด) or *Long* (หลง)**

This refers to locations in the former mainstream of a river that become isolated when the river changes its course. Some of these locations become marshes known as *bung* or *nong*. They are curved in shape and are known as *oxbow lakes*. There are two types of *kut* or *long*. One type is where water is present all year round and which is connected to the new river channel in the rainy season, while the other dries out in the dry season and only accumulates water in the rainy season. These are known as *oxbow scars* in specialist terminology. There are a great number of *kut* or *long* in the middle Mun River basin and these are important fishing grounds for the local residents.

Non Tharm, Don Tharm (โนนทาม ดอนทาม)

These are locations in the *paabung paathaam* which are higher than their surroundings and are almost never inundated. They lie adjacent to *kut, nong or hong*. They act as refuges for wildlife during times of flooding. Vegetation is terrestrial.

Hong (ฮ่อง)

A small water channel that flows through a flooded forest and into a *kut* or the river. Some of these are water sources for *kut, nong* or the river.

Nong (หนอง)

Small areas of low-lying land where water accumulates. Very small ones are known as *buak* (บวัก).

Loeng (เลิ่ง)

Flat and shallow water channels that flow into *kut* and the river mainstream.

Wang (วัง)

Where the Mun River winds, these are locations that are broader and deeper than other curved locations.

4.2 Local Residents' Knowledge on fish in the middle and lower Mun River basins - results of the 2012 survey

Mekong Watch conducted an interview survey with respect to local residents of the middle and lower Mun River basins in 2011 to 2012, resulting in the following data (Mekong Watch, unpublished document, 2012).

Revised summary of individual interviews on fish spawning behavior in the middle Mun River basin

Fish/Local name (Scientific name)	Data on spawning	Notes (Spawning ground)
<i>Pa Itai</i> ปลาอีโถ (<i>Osteochilus microcephalus</i> , <i>O. waandersi</i> , <i>O. lini</i> , <i>O. hasselti</i>)	<ul style="list-style-type: none">• Broadcast spawning, any water depth.• Spawns in flowing <i>kut</i> or <i>hong</i>. The fish leap in schools at periods thought to be spawning periods.• This can be at any time in the day.• Eggs can be seen and are white.	NA

<p><i>Pa Khao</i> ປາຫ້າ (<i>Wallago attu</i>)</p>	<ul style="list-style-type: none"> • Can be caught when a dam water gate is opened. Before the Rasi Salai Dam was built, since the fish swim into <i>kut</i> when the water level rises, fishing was carried out in the <i>hong</i> (water channel) around midnight. 20 to 30 fish enter the <i>kut</i> at one time. • Broadcast spawning. • The fish enter the <i>kut</i> when the water rises in the 6th lunar month. Spawning occurs in the 7th lunar month, eggs being laid on a water weed known as “<i>nē</i>” and on lotus stalks. Spawning occurs underwater, but the eggs are hidden after they are laid. As the water weed does not grow in places where the water depth is over 2.5m, it is supposed that spawning occurs within that range of depth. Numbers are now greatly reduced. • Spawning occurs in August/September in locations in <i>kut</i> where there are immersed trees. Eggs hatch in 15 days. • Spawning takes place at depths of 3 to 4m. I have not seen the eggs, but I sometimes see 4 or 5 fish grappling together. 20 to 30 fish enter the water channel together. • I see them during the day splashing the water ferociously. I don’t know if they also behave the same way at night. 	<p>Views differ on the spawning period, but it is known that the fish enter <i>kut</i> by swimming through <i>hong</i> from the Mun River mainstream as the water level rises. At that time, they move in schools.</p> <p>Spawning grounds:</p> <ul style="list-style-type: none"> • <i>Kut Ee-dor, Kut Luang, Kut Yiap, Kut Pamar.</i> • <i>Kut Khakhim</i> (Ratanaburi District, Surin Province, etc.). • <i>Kut Nam Sai</i> <p>Spawning used to occur in the 6th lunar month.</p>
<p><i>Pa Khayeng</i> ປາຂະແມງ (<i>Mystus mysticaetus, Mystus artifascatus, Mystus singaringan</i>)</p>	<ul style="list-style-type: none"> • Makes a sound like “mut-mut-mut”. • After started the rainy season (in a period known as <i>nam daeng</i>), spawning takes place in <i>kut, wang</i> and <i>hong</i>. Broadcast spawning. 	<p><i>Kut Ee-dor, Kut Khe khaw.</i></p>
<p><i>Pa Kum</i> ປາກຸມ (<i>Thynnichthys thynnoides</i>)</p>	<ul style="list-style-type: none"> • Spawning occurs in locations where the <i>kut or hong</i> are flowing. In the period thought to be the spawning period, the fish leap in schools, but this can happen at any time of day. • Eggs can be seen and are white. 	<p>NA</p>
<p><i>Pa Kot</i> ປາກອ (<i>Hemibagrus nemurus, Hemibagrus filamentus, Hemibagrus wyckioides, Hemibagrus wycki</i>)</p>	<ul style="list-style-type: none"> • Eggs are sprinkled in deep locations. During the time when the river water is turbid (at the beginning of the rainy season), if you put your hand into a rocky place, small fish will prod your hand. • Fish carry eggs in the 7th to 8th lunar months. • Spawning occurs around the 6th lunar month (in the period known as <i>nam daeng</i>). • Eggs are carried from the end of April, and spawning occurs at the beginning of the rainy season. 	<p>There is some difference of opinion about the period when eggs are carried and depth of spawning grounds, but common agreement that spawning takes place in locations where the</p>

	<p>You can tell that the fish have spawned because they become thinner. Broadcast spawning near river banks with trees. I think the eggs hatch within 15 days.</p> <ul style="list-style-type: none"> • The fish make a sound during the spawning period. They breed in locations where the water is flowing and form schools during the breeding period. • Spawning occurs in the 6th to 7th lunar month and the fish do not breed in places where the water is not flowing. They broadcast spawn in shallow water, showing breeding behavior at night (in the evening). They make a sound like “putt-putt-putt”. • I think the fish lay their eggs in deep water, but I have not seen them spawning. They do not guard their eggs. • <i>Pa Kot</i> make a sound. It is like the “ee-ee” cry of pigs. • There are no specific spawning grounds; the fish will spawn anywhere in the Mun River or <i>kut</i> where there is an environment with submerged tree stumps. • <i>Wang Yai</i> is the place at the confluence of the Nam Siao and the Mun River. Fish gather there. <i>Pa Kot</i> do broadcast spawning there at the end of April. 	<p>water is flowing.</p> <p>Spawning grounds: <i>Wang Yai, Wang Kut Sorn.</i></p>
<p><i>Pa Tong Kai</i> ปตองกาย (<i>Chitola Ornata</i>)</p>	<ul style="list-style-type: none"> • I have felt what I think to be <i>Pa Tong Kai</i> eggs where there are submerged tree roots. • The fish spawn around tree roots at a depth of 2 to 3m and guard the eggs. They dig a shallow hole about the same size as their body. They stay in the nest even after the fry have hatched. • The fish enter the <i>kut</i> and make a nest on the parts of branches and tree roots that are protruding out into the water. The depth is just under 2m. I don’t know if it’s the male or the female, but they will threaten any person that approaches. 	<p>A common awareness was that the fish make a nest and spawn in locations where roots are protruding out from tree stumps, etc. and the parent fish guard the eggs.</p>
<p><i>Pa Nang</i> ปนาง (<i>Micronema bleekeri</i>, <i>Micronema apgon</i>, <i>Micronema micronema</i>)</p>	<ul style="list-style-type: none"> • Fishing people report seeing eggs in <i>tham</i> (ถ้ำ submerged caves). People are threatened in the vicinity by what appear to be the parent fish. • <i>Pa Nang</i> spawn at depths of 9 to 10m, where there are no natural predators such as snakes. The fry that hatch from the eggs after about 15 days hide separately under trees, etc. Small fish are seen in the 7th lunar month. • The fish make nests in <i>tham</i> that are about 2 to 3m in depth. Two fish guard the eggs. They make their 	<p>The depths of the places thought to be spawning grounds vary, but there is a common awareness that the fish spawn in submerged caverns known as <i>tham</i>.</p> <p>Spawning grounds: <i>Wang Tapho, Wang Yai</i></p>

	nests in places where the riverbed is clayey. • <i>Wang Tapho</i> is deep and has layers of rocks at the bottom of the pool. This is the spawning ground for the <i>Pa Nang</i> and they spawn in the rocky area in the <i>tham</i> . • I have seen nests in <i>Wang Yai</i> .	
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* Scientific names are from the Ubon Ratchatani University (2002) survey and are shown here as a comparison with the local names.

4.3 Field Survey

4.3.1 Middle Mun River basin fish and spawning grounds from question sheet data

As a result of conducting interviews based on survey sheets, the author and the local resident survey assistants collected data on 24 fish species from 45 individuals in eight villages (essentially seven villages, as only one respondent could be surveyed in a village that was visited during an environmental campaign event). The fish that were the subject of the interviews were those concerning which the respondent believed she/he had seen spawning behavior. The question sheet asked about matters such as sounds made by the fish, color changes, swimming in schools and other behaviors thought to be related to spawning behavior. Respondents were also asked where those behaviors could be seen, and where small fish thought to be the young fish could be seen. Furthermore (see attached survey sheet), respondents were limited to local residents or their acquaintances who were participating in the livelihood recovery projects for Rasi Salai Dam or Hua Na Dam, and were not representative of their villages as a whole.

Scientific names in brackets alongside the local names are given as reference and are the scientific names given in the Ubon Ratchathani University (2002) report.

- *Pa Hak Kluay* ปลาหกกล้วย (*Acanthopsoides* sp.) (3 responses)
- *Pa I-kam* ปลาอีท่า (*Labero barbatulus* or *L. Chrysopheadion*) (3 responses)
- *Pa I-thay* ปลาอีไท (*Osteochilus microcephalus*, *O. waandersi*, *O. lini*, *O. hasselti*) (20 responses)
- *Pa Jork* ปลาจอก (*Cyclocheilichthys enoplos*, *C. furcatus*) (4 responses)
- *Pa Khao* ปลาข้าว (*Wallago Attu*) (7 responses)
- *Pa Khaao* ปลาขาว (*Cyclocheilichthys heteronema*) (2 responses)
- *Pa Khajeng* ปลาตะแบง (*Mystus mysticaetus*, *M. artifascatus*, *M. singaringan*) (8 responses)

- *Pa Khoeng* ปากึง (*Hemibagrus wyckioides*) (3 responses)
- *Pa Khop* ปากหม (*Belodontichthys truncatus*) (1 response)
- *Pa Khuylam* ปากขลุยม (*Labiobarbus leptocheilus*) (6 responses)
- *Pa Kot* ปากคด (*Hemibagrus nemurus*, *H. filamentus*, *H. wyckioides*, *H. wycki*) (10 responses)
- *Pa Kum* ปากกุ่ม (*Thynnichthys thynnoides*) (5 responses)
- *Pa Lot* ปากลต (*Macrogathus* sp.) (1 response)
- *Pa Muu* ปากมู (*Botia* sp.) (1 response)
- *Pa Nang* ปากนาง (*Micronema bleekeri*, *M. apgon*, *M. micronema*) (4 responses)
- *Pa Nok Khao* ปากนกกเขา (*Osteochilus melanopleurus*) (4 responses)
- *Pa Piik Kai* ปากปีกไก่ (*Kryptopterus palembangensis*) (1 response)
- *Pa Pung* ปากปึง (*Pangasius larnaudii*) (2 responses)
- *Pa Soy* ปากสร้อย (*Henicorhynchus* sp., *Labiobarbus* sp.) (19 responses)
- *Pa Suam* ปากเซียม (*Ompok siluroides*) (3 responses)
- *Pa Suut* ปากสุต (*Hampala Dispar*, *H. macrolepidota*) (1 response)
- *Pa Taep/Pa Peap* ปากเตบ ปากเปบ (*Parachera* sp. *Paralaubuca* sp.) (1 response)
- *Pa Lart* ปากลาด (*Mastacembelus* sp.) (1 response)
- *Pa Yon* ปากยอน (*Pangasius macronema*) (1 response)

• ***Pa Hak Kluay* (3 responses)**

The name of this fish means “banana roots”. The fish prefers beaches and is reported to be seen gathering at beaches at night. The local residents use this trait of gathering at sandy beaches by setting traps on the river banks to catch them. Views on the



egg-carrying period differ, with reports of January/February, April/May and in the rainy season. Spawning takes place on sandy beaches or under fallen trees in the flood plain. Two responses said that at that time the fish swim in pairs. A common view was that the fish carry out broadcast spawning. Small fish are seen in the period August to October.

• ***Pa I-kam* (3 responses)**

Two responses suggest that egg-carrying takes place in the third to tenth lunar months or in the ninth to tenth lunar months, and that the fish swim in pairs. Broadcast spawning takes place at the beginning of the rainy season in rocky locations or places where there are fallen trees. Spawning takes place anywhere.



• ***Pa I-thai* (20 responses)**

There were a large number of responses for this fish. Egg-carrying is seen mainly at the beginning of the rainy season. It is reported that the fish make a sound during some period and gather in schools in the spawning period. The spawning period is mainly in the rainy season, and fish have been observed to spawn during the daytime. Some report that spawning takes place at any location and many reports say that spawning takes place under submerged forests in the flood plain. Broadcast spawning. One response said that before construction of the dam, spawning occurred in the period from the dry season to the beginning of the rainy season, and two responses mentioned that after dam construction the fish are carrying eggs when the water level rises. It is possible that the fish behavior changed due to dam construction.

• ***Pa Jork* (4 responses)**

It is reported that the fish carry eggs during *Nam Lark* (the time when the water level rises at the start of the rainy season) or in the sixth lunar month or in the seventh to eighth lunar months, and that spawning takes place during the rainy season. Two responses



reported that when spawning the fish swim in pairs and one response said that a large number of fish swim together. There was no information on fry.

• ***Pa Khao*** (7 responses)

The fish carry eggs in the rainy season or in the seventh to eighth lunar months. It is reported that at a certain time the fish make a sound and swim in pairs when spawning. When spawning, the fish enter *hong*, water channels that connect the mainstream of the river with the former river course. The fish make a nest at the spawning grounds, in oxbow lakes, at a depth of 2 to 3m or 7 to 8m. Three responses reported that the parent fish guard the eggs. One response noted that the fish return to the place where they were born.



• ***Pa Khaao***¹ (2 responses)

It is reported that at a certain time the fish make a sound and that they carry eggs all year round or in the rainy season. Spawning takes place at night or at 7 to 8 o'clock in the morning. There is no information on fry.

• ***Pa Khajeng*** (8 responses)

Five responses report that the fish carry eggs during the rainy season and become a white color during that period, and five responses also note that the fish make a sound. At spawning time, the fish form schools; spawning time is in the rainy season, and broadcast spawning takes place in flooded forests at a depth of 1 to 5m. Spawning occurs at night.



• ***Pa khoeng*** (3 responses)

Egg-carrying takes place in the eighth to ninth lunar months, the fish making a sound at a certain time, and swim in pairs. Broadcast spawning occurs in the evening or at night in locations where there are fallen trees.

• ***Pa khop*** (1 response)

Eggs are carried around the eighth lunar month and spawning is broadcast spawning.



¹ As the name ***Pa Khaao*** is also used as a generic name for small fish in the *Cyprinidae* (carp) family, it is unclear which fish species the informants are referring to.

• ***Pa Khuilam*** (6 responses)

Carries eggs in the rainy season or in the sixth to seventh lunar months. Four responses report that the fish make a sound at a certain time. The fish swim in schools and slap the water during the spawning period. Two responses note that the fish gather and then swim in pairs. The spawning period is in the rainy season, but responses concerning the time of day varied. It appears that spawning can take place anywhere. The spawning grounds are in shallow places or at a depth of 2 to 4m. Broadcast spawning, but places with water weeds seem to be preferred. One response reported that the fish carry out broadcast spawning, but guard the eggs. One report stated that before the dam was built the spawning period was late in the dry season, from April to July, but after the dam was completed the spawning period changed the time when the water level rises.

• ***Pa Kot*** (10 responses)

Eggs are incubated in the sixth to seventh lunar months. The fish make a sound at a certain time. At a time thought to be the spawning period, five responses report that the fish swim in schools and four



responses report that the fish swim in pairs. This behavior is seen in the evening or at night. Views differ on whether the spawning grounds are at a 1m depth or 4 to 5m depth. Small fish are seen in the tenth and eleventh lunar months. Five responses report that the fish make nests. Two responses said that spawning is by broadcast, one response said that the eggs are laid under fallen trees, and one response stated that two fish guard the eggs. Regarding the location of young fish, one report stated shallow places in marshes and one reported in pools.

• ***Pa Kum*** (5 responses)

Different views stated fifth to sixth, seventh to eighth and seventh to tenth lunar months for egg-carrying. In the tenth lunar month the fish have no eggs. At a certain time, the fish make a sound swim in schools. The fish slap the water (one response) or chase each other (two responses). The fish are said to carry out broadcast spawning in pools or flooded forests. Different informants reported that this behavior is seen in the morning, in the evening or at anytime. Two reports stated that small fish are seen in *wang* (pools).

• ***Pa Lot*** (1 response)

Eggs are incubated in August/September. The fish swim in pairs and spawn by broadcasting on riverbeds where there is sand or mud.



• ***Pa Moo*** (1 response)

The fish carry eggs in the eighth lunar month. The fish make a sound at a certain time and swim in pairs. It is thought that the fish take what appears to be spawning behavior at night in the rainy season, but there is no information about young fish.



• ***Pa Nang*** (4 responses)

Eggs are carried in the rainy season or in the sixth lunar month or in July/August. One response states that the fish change color, and three responses say that the fish make a sound at a certain time. The fish have no eggs around August. Two responses report that the fish swim in schools and two responses report that the fish swim in pairs. It is thought that spawning is at night in



deep pools of at a depth of 2 to 3m in oxbow lakes. One response stated that one of the parent fish guards the eggs.

• ***Pa Nok Khao*** (4 responses)

Differing views say that the spawning period is in the third to tenth lunar months, the seventh to eighth lunar months or the ninth to tenth lunar months, but that eggs are not seen in the eleventh lunar month. The fish swim in pairs (two responses), and carry out broadcast spawning in rocky places or in locations with submerged trees (three responses). One response stated that spawning occurs under fallen trees. The water depth is 2 to 3m or 3 to 4m.



• ***Pa Peek (Piik) Kai*** (1 response)

Egg-carrying is in the *nam lark* period. It is reported that the fish swim in pairs and make nests near the banks of the Mun River.



• ***Pa Pung*** (2 responses)

Eggs are carried in the sixth lunar month or in the rainy season, and eggs are not seen in the tenth or eleventh lunar months. The fish make a sound at a certain time and are seen to swim in pairs at night. The location is *Wang Yai* (pool). One response reports that the eggs are guarded.

• ***Pa Soy*** (19 responses)

Many observations. Eggs are carried mainly in the rainy season, and there is the view that this was in May to July before the dam was completed, but this has now become year round. The fish change color at a certain time (three responses) and many people say that the fish make a sound (15 responses). At the time thought to be the spawning period, the fish swim in schools and slap the water. The fish carry out broadcast spawning during the day or in the morning or evening, at a depth of 2 to 3m or at any depth. Two responses state that the fish lay their eggs in locations where water weed is growing, and one response says that the fish guard the eggs.



• ***Pa Suam*** (3 responses)

Eggs are carried in the sixth lunar month or in the rainy season, the fish make a sound at a certain time, and swim in pairs (two responses) or swim in schools (one response). The fish make nests at places with a depth of 1 to 2m or 2 to 3m (two responses) and carry out broadcast spawning (one response).



• ***Pa Suut*** (1 response)

The fish make a sound in the spawning period in the seventh to eighth lunar months, and swim in pairs. The fish carry out broadcast spawning in oxbow lakes or flooded forests at a depth of 3 to 4m.



• *Pa Taep* (1 response)

The fish carry eggs in the rainy season and make a sound in the incubating period. The fish swim in pools in the spawning period, and carry out broadcast spawning at a depth of 2 to 3m in locations with water weed. The fish like to feed on weaver ants (*Oecophylla smaragdina*).



• *Pa Lart* (1 response)

Eggs are carried in the sixth lunar month, when the color of the fish changes and they swim in pairs. Spawning takes place at night at a depth of 2 to 3m in locations where there are fallen trees.



• *Pa Yon* (1 response)

Eggs are carried in the sixth to eighth lunar months. The color of the fish changes when they are carrying eggs and they make a sound. In the spawning period, the fish swim in pairs, and broadcast spawning is carried out under fallen trees in locations with flowing water between 6 pm and 8 pm on days when heavy rain has fallen.



4.3.2 Data for each of the surveyed villages

Below, as case examples, for the three villages that were able to provide data on specific spawning grounds and nursery grounds, locations where fish thought to be young fish gathered, the environments and locations, and the fish which use them, are summarized in tables. (Proper nouns for the fish all begin with the word “*Pa*”, meaning “fish”, but this word has been omitted from the names of fish in the tables for brevity.)

Nongtao หมู่บ้าน (8 respondents)			
Spawning grounds			
Ecosystem	Fish (Local Name)	Place	Fish (Local Name)
Near river banks, under submerged bushes	<i>I-kam, Khayeng, Kot</i>	<i>Kut khaek khao</i>	<i>I-thay, Kot</i>
<i>Kut</i>	<i>I-thay, Khao</i> ^{๓๗๖} , <i>Khuylam, Kot</i>	<i>Kut I Jork,</i>	<i>Kot, Nang</i>
<i>Nong</i>	<i>I-thay, Khao</i> ^{๓๗๖} , <i>Khuylam</i>	<i>Kut Idok</i>	<i>Jork, Khayeng, Nok khao, Suut</i>
Near river banks / riverside	<i>I-thay, Kum, Soy</i>	<i>Kut Khaek khao</i>	<i>Khao, Kot, Jork, Khayeng, Nok khao, Soy, Suam, Suut</i>
<i>paabung paathaam</i>	<i>I-thay, Kot, Jork, Nok khao, Suut, Kum, Soy</i>	<i>Kut Kwang</i>	<i>Nang</i>
Trees and rocks in water	<i>Nok khao</i>	<i>Wang Yai</i>	<i>Khao, Khoeng, Pung</i>
Under submerged trees	<i>Kot, I-thay, Khayeng, Suam</i>		
<i>Wang</i>	<i>Kum, Soy</i>		
Nursery grounds			
Ecosystem	Fish (Local Name)	Place	Fish (Local Name)
Near <i>Kut</i> river banks	<i>I-thay, Soy</i>	<i>Kut I(Ee)-do</i>	<i>Nang</i>
Rocky places on riverbed	<i>Khao</i>	<i>Kut Khaek khao</i>	<i>I-thay, Soy</i>
<i>Kut</i>	<i>Khayeng, Kot</i>		

At Nongtao village, it is suggested that oxbow lakes of the former river course, known as *kut*, perform an important role as spawning grounds. In addition, flooded forests, known as *paabung paathaam*, are also mentioned as an environment that is used by fish as a spawning environment. The names of five *kut* were given as spawning grounds, including *Kut Ee-dok* as a spawning ground for *Pa Jork*, *Pa Khayeng*, *Pa Nok khao* and *Pa Suut*.

Nong Viengkham อุดเวียงคำ (8 respondents)			
Spawning grounds			
Ecosystem	Fish (Local Name)	Place	Fish (Local Name)
Around submerged rocks and trees	<i>Nok khao, Piya (or I-kam)</i>	<i>Kut Viengkham</i>	<i>I-thay, Khao, Soy</i>
<i>Kut</i>	<i>Khayeng, Kot</i>	<i>Pak Ee Jong</i>	<i>I-thay, Soy</i>

Places where water is flowing	<i>Khuylam, Soy</i>	<i>Tha Ban</i>	<i>Hak Kluay</i>
Submerged trees	<i>Taep</i>		
<i>Wang</i>	<i>Kum, Soy</i>		
Near river banks	<i>I-thay, Khuylam</i>		
Near sandy shores	<i>Hak Kluay</i>		
Nursery grounds			
Ecosystem	Fish (Local Name)	Place	Fish (Local Name)
Near river banks	<i>I-thay, Soy, Khao (ขาว)</i>	<i>Kut Viengkham</i>	<i>Taep</i>
<i>Pak Ee Jong, near the bank</i>	<i>I-thay</i>	<i>Pak Ee Jong</i>	<i>Soy</i>
		<i>Wang Hin</i>	<i>Nang</i>
		<i>Wang Khae</i>	<i>Nang</i>

At Nong Viengkham village, it was reported that the fish use *kut* and *wang* for spawning. Respondents also noted that what are thought to be young *Pa Nang* fish could be seen in the two pools *Wang Hin* and *Wang Khae*, though the spawning grounds are unknown.

Phiyamart Village เพียงมาตร (5 respondents)			
Spawning Grounds			
Ecosystem	Fish (Local Name)	Place	Fish (Local Name)
Sandy shores	<i>I-thay, Soy</i>	<i>Hong Hua Pu</i>	<i>Kot</i>
<i>Nong</i>	<i>Khayeng, Soy</i>	<i>Hong Oy Nu</i>	<i>Kot</i>
Riverbeds of sand or mud	<i>Khuylam, Lot, Hak Kluay</i>	<i>Hong Pheng,</i>	<i>Kot</i>
<i>Hong</i>	<i>Kot,</i>	<i>Wang Bang Tha</i>	<i>Kot, Nang</i>
<i>Wang</i>	<i>Kot, Nang</i>	<i>Wang Hin</i>	<i>Kot, Nang</i>
		<i>Wang Khaeng</i>	<i>Nang</i>
		<i>Wang Yai</i>	<i>Kot</i>
Nursery grounds			
Ecosystem	Fish (Local Name)	Place	Fish (Local Name)
Rocky <i>Tham</i>	<i>Kot</i>	<i>Wang Kha mo</i>	<i>I-thay, Khuylam, Soy</i>
<i>Kut</i>	<i>Kot</i>	<i>Wang Kok Kabao</i>	<i>Soy</i>
<i>Nong</i> (in <i>Tharm</i> forest)	<i>Lot, Hak Kluay</i>	<i>Kut Wang Pheng</i>	<i>Kot</i>
Fast-flowing parts of rivers	<i>Soy</i>	<i>Nong Krok</i>	<i>Kot</i>
Near banks of Mun River	<i>Pik Kai</i>	<i>Wang Hin</i>	<i>Kot, Nang</i>
Narrow places in <i>Nong Tao hua</i>	<i>Kot</i>	<i>Wang Bang, Wang Ban Tha</i>	<i>Kot</i>
Under submerged	<i>Kot</i>	<i>Nong Tao huat</i>	<i>Kot</i>

trees			
<i>Wang</i>	<i>I-thay, Khuylam, Soy</i>	<i>Hong Hua Pu, Hong Pheng, Hong</i>	<i>Kot</i>
		<i>Wang Khaeng</i>	<i>Nang</i>

In the surroundings of Phiyamart village, water channels, known as *nong* or *hong*, and pools, known as *wang*, are used by fish for spawning. *Pa I-thay* and *Pa Soy* also use sandy banks for spawning. It is also thought that *Wang Kok Kabao* is used as a spawning ground by *Pa Soy*, and that *Wang Bang*, *Wang Ban Tha*, *Nong Tao Huat*, *Hong Hua Pu*, *Hong Oy Nuu* and *Hong Pheng* are used by *Pa Kot* as spawning grounds. *Wang Bang Tha*, *Wang Hin* and *Wang Khaeng* are used as spawning grounds by *Pa Nang*. Small fish thought to be young fish are seen in pools, *kut* and *hong*, but are often observed in locations where the water is flowing rapidly and in shallow places.

4.3.4 Additional Data from Interviews

In the interviews with local residents, it was suggested that after the construction of the Rasi Salai Dam there were fish whose numbers declined and others whose numbers did not decline. The fish whose numbers declined were *Pa Nang* (“fish”, “skin” = “skin fish”), the local residents’ classification for scaleless fish, which refers to catfish-like fish species. For some of these fish species (e.g. *Pa Khao: Wallago Attu*) water level rise is the cue for them to enter and spawn in former river channels that connect to the mainstream when the water flow volume increases. It is also reported that these fish carry eggs during a short period after the water level has risen. In contrast, fish of the Cyprinidae (carp) family (e.g. *Pa I-thai* and *Pa Soy*) are thought to carry eggs for a long period.

4.3.5 Summary

Overall, eye-witness information on *Pa I-thai* and *Pa Soy* was plentiful. It is surmised that the reasons for this are that the spawning behavior of these two fish species takes place in locations that are easy for people to find, and that there are abundant resources of these two fish species, making it possible that they are easily seen by people. The fish with the next largest number of responses was *Pa Kot*, but there was some variation in the information received from different respondents and it is possible that the fish are able to spawn in a wide range of environments. In addition, some reports stated that spawning behavior and egg-carrying states that were formerly seen at particular times once each year had altered such that, for some fish, breeding has been seen in accordance with the rising and falling of water levels since the dam was built. For other fish species, it will be necessary to gather further data in the future.

4.3.6 Future Survey Tasks

A focus group interview survey was conducted in 2012, but as it was not possible to completely detail all the information held by individuals, question sheets were provided to the interviewers in this survey and individual interviews conducted. The number of subjects participating in this question sheet survey was few, at 45, and the results do not express the conditions in each of the villages as a whole.

If the survey were conducted in village units, including as many of the fishing people as possible,

it is thought that it would be possible to elucidate the spawning behavior of various fish species from the knowledge of the local residents, and to clarify the environments and spawning grounds used by some of the fish species in the village surroundings. It should also be noted as merits of the survey method that the local residents themselves are able to gather data without the use of any special equipment and that there are no costs incurred.

At the same time, the limitation of this method, since it relies on knowledge held by local residents, is that data is gathered only on fish that the local residents see frequently, as is suggested by the outcome of this survey. Thus there is a strong possibility that the survey outcome includes spawning grounds for fish species that have a certain resource size, but does not include these for fish whose resource size has already declined dramatically and for which there is little eye-witness information. For this reason, it is necessary to supplement the data by interviewing older residents to gain information on spawning in the time before dam construction.

Furthermore, this survey did not discover in detail the changes in river topography that took place before and after the construction of the Rasi Salai Dam. It will therefore be necessary in future surveys to gain information about changes in river topography at locations for which names have been mentioned in this survey.

Future tasks are to revise the questions in the parts where there was some confusion in responses to the survey sheet (habitat environment and specific place names) and to carry out training for local residents of the target villages on filling out the survey sheets. Following surveys, the results should be entered on maps of the village surroundings and then the data verified at the actual sites by the interviewers (local residents). It is hoped that through this work, in which the local residents themselves confirm the spawning grounds in the village surroundings, local residents will form an awareness of locations where fish conservation will be needed in the future and engage in a process of sharing this awareness within the village.

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