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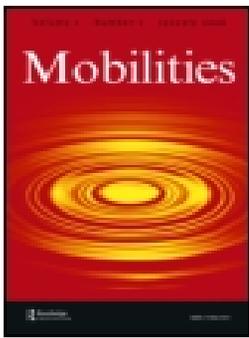
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To cite this article: Ian G. Baird & Kanokwan Manorom (2019): Migrating fish and mobile knowledge: situated fishers' knowledge and social networks in the lower Mekong River Basin in Thailand, Laos and Cambodia, *Mobilities*

To link to this article: <https://doi.org/10.1080/17450101.2019.1635343>



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# Migrating fish and mobile knowledge: situated fishers' knowledge and social networks in the lower Mekong River Basin in Thailand, Laos and Cambodia

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## ABSTRACT

Various terms are used to characterize fishers' knowledge. Here we use *situated fishers' knowledge* to refer to knowledge about long-distance fish migrations held by ethnic Lao fishers living in the Mekong River Basin in northeastern Thailand, southern Laos, and northeastern Cambodia. We consider the mobility of knowledge, humans, and fish, and adopt a theoretical framework based on Actor Network Theory (ANT) and political ecology. Based on fisher interviews, we demonstrate why knowledge transfer related to fish migrations is important. Fishers have various ways of knowing when migratory fish pass certain locations, although those are changing due to borders and technological changes. The paper's main contribution is to move beyond simply investigating human mobilities, and to instead consider the relationships between human, fish and knowledge mobilities, something that ANT is particularly well suited for, due to its focus on multispecies interactions, something that mobilities scholars would benefit from paying more attention to.

## ARTICLE HISTORY

Received 16 December 2019  
Accepted 04 June 2019

## KEYWORDS

Local Knowledge; fish migration; Laos; Thailand; Cambodia

## Introduction

Mobilities scholarship is frequently considered to encompass the study of 'different types of movement (of people, objects, capital, information), as well as their intersections and dynamics across multiple systems and scales' (Hannam, Sheller, and Urry 2006, 1). In reality, however, most mobility studies deal only with human mobility (Kelly 1983; Sugimoto 2016). Although always considered to be part of mobility studies, there has been less interest in information or knowledge mobilities, and non-human species mobilities. This study, however, considers freshwater ecosystems – particularly in the Mekong River Basin – knowledge mobilities, and the mobilities of humans in relation to freshwater migratory fish.

So, what is the best way to address this kind of research? Diverse forms of knowledge have received increased recognition over the last few decades. For example, indigenous knowledge systems, including fishers' knowledge, are now recognized as important for environmental management (Haggan, Neis, and Baird 2007; Silvano et al. 2006; Baird and Flaherty 2005). Much of this knowledge is considered place-based, where place is conceptualized as spatially bounded or static. A growing number of scholars have, however, recast our understandings of place as dynamic, and fishers' knowledge systems as flexible and fluid assemblages of adaptive learning and practice (Berkes 1999). Knowledge passes over space and time, albeit unevenly, and is based on dialectical relationships between both (Hägerstrand 1970). It also affects the mobilities of non-human species, including how reindeer movements in northeastern Siberia affect the mobilities of human reindeer

herders (Vitebsky and Alekseyev 2015). As Faulconbridge and Hui (2016, 8) have pointed out, mobilities research is intended to focus 'on understudied phenomenon, whilst also highlighting the contributions of the field in relation to wider social scientific debates.' That being the case, it seems appropriate to explore the understudied intersections between human, fish and knowledge mobilities.

Over the last few decades, geographers have shown increased interest in mobilities. Rather than focusing as much on distance between places and peoples, as classical economic geographers often did, a focus on mobilities signals more emphasis on the movements of people and things across space (Cresswell 2006; Urry 2007; Frello 2008). There is also increasing interest in new directions, such as how immaterial knowledge flows through varied networks (Greenblatt 2009; McCann 2011; Baird and Vue 2017), and how mobility is viewed through the prism of the internet (Aouragh 2011).

This paper is focused on fishers' knowledge and information mobility, particularly in relation to mobile aquatic animals: freshwater fish that conduct long distance migrations along the main-stream Mekong River and tributaries at different times of the year (see Figure 1). This study is not, however, only about the mobility of people, fish and knowledge; it also relates to the social networks that facilitate the transfer of knowledge across space. Social networks associated with knowledge transfer are not static. Instead, fish traders – as Bush (2004) states in his article about networks associated with fish trade in southern Laos – 'continually negotiate their space in the network.' Many other geographers have also shown interest in how spaces linked to the transfer of commodities are negotiated (Murdoch 1998; Leslie and Reimer 1999). Some authors have applied Actor Network Theory (ANT) to 'analyse how social and material processes (subjects, objects and relations) become seamlessly entwined within complex sets of associations' (Murdoch 1998, 359). Key to ANT – which came out of *science and technology studies* (STS) – are putting all factors associated with a social circumstance on the same level, and thus doing away with the concept of social forces. This results in all relevant factors – such as objects, living entities, and ideas – becoming understood as potentially important in the construction of social processes. In other words, non-humans – whether living or not – are understood to have particular forms of agency (Latour 2005). We too are interested in how networked space is negotiated and altered, but rather than focusing on fish trading or the marketing of other products, we consider how knowledge about fish migrations is understood, learned, applied, and transferred over space and time in northeastern Cambodia, southern Laos, and northeastern Thailand. In other words, rather than tracking the transfer of material goods, as is typical through ANT, we are interested in the transfer of immaterial knowledge, albeit about migratory fish stocks. We see social and material processes as fundamentally intertwined.

Although Bruno Latour, when he initially developed the concept of ANT, did not believe that geography and space had anything to offer ANT (Latour 1987), Murdoch (1998) and others have since stressed that space should not be conceptualized in Euclidean, two-dimensional geometric ways, but rather as a continuously shifting set of relations. Here the idea of the relationality of space becomes crucial. Thus, through thinking about the above using ANT, we examine how knowledge about fish migration spatialities and timings are understood by rural fishers in northeastern Thailand, southern Laos and northeastern Cambodia, how knowledge was transferred over space in the past, and how its mobility has changed. In addition, we consider how these changes are related to social networks and technologies. We contend that fishers' knowledge regarding the long-distance fish migrations that we are focusing on is contextual, mobile and dependent on various social factors and technologies.

In doing this, we are also attentive to political ecology, even though we recognize that the field encompasses a wide diversity of ideas and perspectives (Robbins 2004). But from our view, at its core political ecology combines political economy with ecology broadly defined, and with that in mind, we assert that a political ecology perspective actually fits well with ANT, even if ANT has historically been more attentive to relational approaches. More recently, however, political



**Figure 1.** The study area (northeastern Thailand, southern Laos and northeastern Cambodia).

ecologists have also increasingly embraced relationality (Forsyth 2003; Robbins 2004), so these two perspectives are now more compatible, but political ecology contributes more with regard to political economy and uneven power relations.

Thus, the main contribution of this paper is to move beyond investigating just human mobilities, and to instead consider the intersection between human, fish and knowledge mobilities. In

this regard, ANT is particularly useful, as it is well suited for considering multispecies entanglements, something that geographers have become increasingly interested in (Hodgetts and Lorimer 2018), and an area that mobilities scholars would benefit from paying more attention to.

In the next part of the paper, we briefly review some relevant issues related to terminology used to describe fishers' knowledge. We then lay out our research methods, and present the results of our research, which provide insights about what knowledge is important for understanding when mainly upriver migratory fish are arriving. We also consider how some forms of short-term knowledge are being transferred across space through social networks, and how knowledge mobility is changing over time, particularly as a result of technological innovations, but also how it is partially impeded by national borders and other barriers, including dams. Linking up these diverse factors is an important goal of this paper, even if doing so necessitates sacrificing some detail.

## Forms of knowledge

There are various types of knowledge, from knowledge generated through scientific inquiry, to long-term and generational knowledge, to short-term and immediate knowledge. Different types of knowledge are, however, frequently intertwined, making it difficult to separate them into distinct categories, such as 'indigenous' or 'scientific' knowledge (Agrawal 1995). These forms of knowledge are, nonetheless, referred to variously as Indigenous knowledge (Agrawal 1995; Hind 2015), traditional knowledge (Parlee, Manseaul, and Autstyl K'E Dene First Nation 2005; Berkes 1999), intimate knowledge (Raffles 2002), local knowledge (Silvano et al. 2006), and situated knowledge (Haraway 1988, 1991). Some simply use the term fishers' knowledge (Haggan, Neis, and Baird 2007). The appropriateness of these terms is contextual, thus making some terms more appropriate in particular contexts. Here we choose to use a term that fits well within the context we are concerned with, but our decision is not intended to preclude or belittle the usage of other terms in different contexts.

We work with fishers who have intimate knowledge of important Mekong River Basin fish migrations. They do not typically define themselves as *Indigenous Peoples*. Neither do the governments in the countries we are concerned with: Laos, Thailand and Cambodia (Baird 2015, 2016a; Baird, Leepreecha, and Yangcheepsujarit 2017). Therefore, using the term 'Indigenous knowledge' is not appropriate. The people we work with rely on knowledge passed down over generations, but it is not only 'traditional' per se, but is also based on recent experiences and observations. Therefore, 'traditional knowledge' does not seem to capture all the elements that are important, and this may result in some people devaluing such knowledge because the terminology leads them to view it as being rooted in the past rather than in the present, even if many do not see it in this way (see Parlee, Manseaul, and Autstyl K'E Dene First Nation 2005; Berkes 1999). Local knowledge is widely applied in the region we work in, but it tends to imply that knowledge is situated only in particular places and is not particularly mobile. Since we want to emphasize the mobility of knowledge, we would rather not apply the term 'local'. Finally, there is situated knowledge – which in some ways emphasizes the fact that much knowledge is situated in places (Haraway 1988; Hinton 2014) – but it seems to us that the term is most appropriately conceptualized as linking knowledge to particular situations or contexts, rather than simply to geographical spaces. This fits well with our interest in mobilities. Indeed, many geographers find the concept of situated knowledges productive. For example, Andrew McGregor (2004, 141) found that the term fit well with post-structural geographers' interests in the spatial nature of knowledge. Haraway (1991) also is wary of applying a so-called 'gaze from above' approach. She emphasizes that localized webs of cultural politics, knowledge, and power are crucial for explaining how truth, including different forms of knowledge, are recognized and legitimated across space and time.

In the Mekong River Basin, knowledge about fish migrations have, up to now, generally been viewed from rather positivist and structural perspectives, with fishers' knowledge being seen by some as important for understanding particular 'truths' about how and when fishes migrate, but

without much attention to examining the social, cultural and political contexts in which particular knowledge emerges, becomes validated and passes in space through particular social networks (see Poulsen et al. 2003; Poulsen and Valbo-Jorgensen 2000).

We too see the value of fishers' knowledge for understanding biological and ecological factors associated with fish migrations, but in this paper we want to take a more situated knowledge approach, so as to be able to consider findings associated with socio-cultural and political factors, rather than just biological and ecological ones. Moreover, we want to consider how new technologies are affecting the ways that knowledge is legitimated, applied and transferred over space and time.

## Methods

In January 2017, we conducted semi-structured interviews, of between 30 minutes and an hour each, with over 50 fishers in over 15 villages near major rivers about the transfer of fish migration knowledge over space and time. Those spoken with were opportunistically found during fieldwork, when we particularly looked for older men with fishing experience to speak with. Since most fishing is gendered, with men doing most fishing for migratory fish, they were our main targets, although we also spoke with some older women. Although interviewing mainly men was intentional and made sense for what we are studying, it limited our exposure to other knowledges that women frequently hold, such as those related to particular fisheries, and some knowledge regarding fish preparation and marketing, work that is more frequently done by women. In our study, we asked mainly about whether interviewees had ways of knowing when fish would migrate upriver to where they lived, before they actually arrived; if they did have such knowledge, how did they acquire it; how does knowledge acquisition – particularly short-term knowledge – occur; and how has knowledge transfer changed over time? We took detailed notes during interviews, as interviewees generally feel less comfortable and willing to discuss sensitive issues when they know they are being recorded. The only quantifiable data collected related to the distances fishers traveled, the distances of people contacted, and the number of days in advance information was collected about fish migrations arrival.

We worked with people living in rural communities located adjacent to large rivers in: northeastern Cambodia (Stung Treng and Ratanakiri Provinces) (Mekong, Sekong and Sesan Rivers); southern Laos (Champasak Province) (Mekong River); and northeastern Thailand (Ubon Ratchathani Province) (Mekong and Mun Rivers). All the people we spoke with were ethnically Lao, and all interviews were done by the researchers in Lao language.

We analyzed the interviews for content, focusing on the importance that informants put on different indicators of fish migrations and how knowledge about migrations is transferred over space and time. We were particularly attentive to geography, networking and political economy. However, it is important to recognize that our analysis is also based on decades of experience conducting research regarding Mekong fisheries. The first author has collected quantitative fisheries data and worked on fishers' knowledge, primarily in northeastern Cambodia and southern Laos, and the second author has worked on fisheries management and knowledge issues in northeastern Thailand. Therefore, this study did not emerge from scratch. For example, we focused on upstream fish migrations because our past experiences suggest that fishers have much more knowledge about them as compared to downstream migrations.

## Fish migrations, knowledge and livelihoods

### *Why is it important that people know when migratory fish are arriving?*

It is already well recognized that fish migrations are important for fisher livelihoods throughout the Mekong River Basin (Warren, Chapman, and Sinhanouvong 1998, 2005; Poulsen and Valbo-Jorgensen 2000; Baird, Flaherty, and Phylavanh 2003, 2004; Roberts 1993, 2001). Indeed, fishers in the Mekong region tend to agree that even though it is generally common knowledge that certain fish migrations occur at particular times of the year, each year there is variability in when

fish arrive at particular locations. For example, dry season small cyprinid fish (i.e. *Henicorhynchus lobatus* and *Paralaubuca typus*) migrate based on lunar cycles. However, their migrations are also linked to hydrological cycles. Essentially, if the time of the lunar year arrives when fish are ready to migrate, they will migrate, but if water levels are still above a certain level, their movements will be delayed a month, and will start at the same time the following month (Baird, Flaherty, and Phylavanh 2003). Therefore, there is variability when these important fish migrations arrive upstream (Baird et al. 1999; Baird, Flaherty, and Phylavanh 2003; Baird and Flaherty 2004; Baran, Baird, and Cans 2005; Warren, Chapman, and Sinhanouvong 1998). This is the type of fish agency that ANT is attentive to.

Other dry season fish migrations are, however, not dependent on lunar cycles, such as medium-sized carps (i.e. *Scaphognathops bandanensis* and *Mekongina erythrospila*) that migrate between the Sekong, Sesan and Srepok Rivers, and the Mekong River. The timings of these migrations are quite variable, and appear to be largely dependent on hydrological factors (Baird and Flaherty 2004).

Similarly, at the beginning of the rainy season, *Pangasiidae* catfish (i.e. *Pangasius conchophilus*, *Pangasius larnaudii*, *Pangasius bocourti* and *Pangasius krempfi*) migrations are dependent on hydrological factors, including water levels and hydrological triggers (Baird, Flaherty, and Phylavanh 2004; Baran, Baird, and Cans 2005). As a result, times of arrival of fish can vary considerably from year-to-year, with peak migrations coming within a range that is about a month long (Baird, Flaherty, and Phylavanh 2004). Still, they generally arrive around the 6<sup>th</sup> lunar month when the river reaches certain levels (is starting to rise) (Baird et al. 1999; Baird, Flaherty, and Phylavanh 2004; Baran, Baird, and Cans 2005; Hogan et al. 2007; Warren, Chapman, and Sinhanouvong 2005). Hydrological triggers are often important determinants of migrations (Baran, Baird, and Cans 2005). This is basic knowledge that generally situates particular migrations.

For all of the above fish migrations, apart from the timings of fish arrivals being somewhat variable, a crucial factor is that peak catches may occur for just a few days or even just a single day. For example, Baird, Flaherty, and Phylavanh (2004, 102) recorded that in relation to *Pangasiidae* catfish rainy season fish migrations at the Khone Falls in southern Laos, on 28 May 1994 just 940 grams of fish were caught in the particular wing trap they were monitoring. On the following day, on May 29, however, the catch increased more than 1,000 fold to 947,960 grams. On May 30, however, the catch had dropped to 26,100 grams. We also found similar patterns during three other years (1995; 1998; 1999). Similar patterns have also been recorded in the Khone Falls area for other fisheries dependent on migratory fish (Baran, Baird, and Cans 2005). The point is that it is crucial for fishers to know when the migrations are arriving, as their window of opportunity can be quite narrow. Moreover, even before the fish arrive, fishers need to prepare their fishing gears and sometimes boats for fishing, and this can take days. For these reasons, having advance warning that the fish will be coming can be crucial for the political economy of fishing, including ensuring that fishers have enough time to prepare for fishing.

The ethnic Lao fishers who participated in our study have a particular socio-territorial organization that relates to their main source of food and sometimes income: wild fish. Because of fish – but also for agricultural, water access and other reasons – ethnic Lao fishers have often historically located their villages next to rivers and streams, and focused their livelihood strategies on these ecological circumstances. Most actually identify as small-scale farmers, growing small amounts of wet rice, mainly for their own consumption. However, fishing is often another important occupation, as 47–80 percent of animal protein typically comes from fish (Hortle 2007: xi), and many people also sell small amounts of fish. These peasants have low incomes, but their expenses are typically low, since they make use of a lot of locally available resources. Boat travel has long been important, and rivers and streams do not only facilitate fish migrations, but also the movements of people, the maintenance of social networks, and the flows of knowledge.

## Knowledge about fish migrations

Through interviews, we have been able to identify three broad types of *fishers' situated knowledges* that are especially pertinent for understanding long-distance Mekong River Basin fish migrations, and can be better understood through combining ANT and political ecology perspectives: (1) bird interactions in nature; (2) environmental interactions in nature; and (3) passing the word on (changes in methods, distance and time).

### Bird interactions in nature

When considering indicators of upriver small cyprinid migrations in the Mekong River in Stung Treng Province and below the Khone Falls in southern Laos, a number of fishers told us that important indicators of the arrival, or soon arrival of *Henicorhynchus lobatus* (*pa soi*) and *Paralaubuca typus* (*pa tep*) were the arrival of river terns (*nok sida*) and Irrawaddy dolphins (*pa kha*) (see, also, Baird and Mounsouphom 1997). In this same geographical area, some informants associate fish migrations with the arrival of '*nok ka nam*' (cormorants) and the arrival of '*leo keo*' (white birds of prey), while in northeastern Thailand they associate the arrival of the same migratory fish with the arrival of '*leo daeng*' (Brahimany kites) (*Haliaster indus*).

Interestingly, however, on the Sesan River in Veun Sai District, Ratanakiri Province, ethnic Lao informants associated the arrival of the same dry season small cyprinid fish migrations with different species of birds, including '*nok khao*' (doves) calling out before *pa soi* migrate up. We were also told that if '*nok katen*' (kingfishers) were observed looking for fish, this also indicated the same fish were migrating up. Crucially, the species of birds used by local people as indicators of the same fish in the Mekong and Sesan Rivers differ. Indeed, geography is important, as are multi-species interactions, and interactions between living-beings and non-living things.

Along the Sesan River, when '*nok kate*' (River Lapwing) baby birds were seen flying, people would know that water levels in the river would soon be going up. This was, however, before the construction of large hydropower dams in the upper stretches of the Sesan River Basin, beginning with the Yali Falls dam, which dramatically changed the hydrological patterns of the river downstream in Cambodia (Wyatt and Baird 2007). Moreover, the construction of the Lower Sesan 2 dam, downriver from Ratanakiri Province in Stung Treng Province, is blocking upriver migrations of fish from the Mekong and Sekong Rivers to Ratanakiri Province (Baird 2016b). Here we can see how the impacts of development, and the environmental changes linked to shifts in the political economy associated with hydropower dam construction, are important contextual factors. Indeed, it should be of little surprise that fisheries knowledge gradually disappears from places where certain species of fish can no longer reach due to being blocked by dams.

### Environmental indicators in nature

Locals living in Veun Sai District, Ratanakiri Province, northeastern Cambodia also spoke of *Henicorhynchus lobatus* migrations being correlated with periods when it is cloudy.

Some fishers there also reported that when it was rainy and the water in the Sesan River became turbid, *Henicorhynchus lobatus* would migrate downriver and *Pangasius krempfi* (*pa souay*) would migrate upriver. They noticed that during this season, *pa kho* (snakeheads) (*Channa striata*) would also migrate up small streams running into the Sesan River.

Just below the Khone Falls, in southern Laos, on the border with Cambodia, fishers spoke of using red algae on rocks near the edge of the Mekong River to indicate that *Henicorhynchus lobatus* and *Paralaubuca typus* migrations would be coming up river within 20 days or so. As with the birds, we found that people in different places use varying indicators to track the same fish migrations. All the above bring together multiple species.

The knowledge discussed so far is not passed on or learned evenly, due to various factors, including political economic ones. For example, it is sometimes passed along during fishing events involving different generations of fishers from the same family or in local networks. It is also

transferred at the community level during community events, when this sort of information might be revealed during discussions. Some people who are not popular or are considered outsiders, or have less financial means, generally have less of a chance to gain such knowledge. We heard from various fishers that money and social networks are crucial. Thus, this knowledge is indeed situated, as it is unevenly transferred across groups of people and spaces. For example, one interviewee told us that his social networks were limited because he could not afford to make longer distance telephone calls. Thus, poverty is linked to less networking opportunities, and this in turn is related to less access to important fishers' knowledge.

### *Passing the word on*

Knowledge mobility and links with social networks and technologies are important when thinking about how short-term knowledge about fish migrations is passed from individual to individual, group to group, and village to village. Historically, before the arrival of motorized boats, motorcycles and other motorized vehicles, fishers used paddle boats to travel up and down rivers, or they simply walked along the banks of rivers. This obviously limited the distance that they could travel, and thus limited networking opportunities with people living farther away. More recently, however, especially beginning in the 1970s and 1980s in northeastern Thailand, the 1990s in southern Laos, and the 1990s and 2000s in northeastern Cambodia, long-tail motor boats became much more common, which facilitated longer distance and less laborious travel up and down the rivers. Moreover, vehicles such as motorcycles and cars have become common in recent years, and road networks have improved considerably, thus making it easier for people to travel longer distances, and expand their social networks over greater distances.

There are two things that warrant further explanation: both relate to geography. First, boats – even paddle boats – have always generally moved faster than migratory fish. For example, small cyprinids migrating up the Mekong River to Southern Laos from the Tonle Sap Lake in Cambodia generally move at between 16–27 kilometers per day, depending on conditions (Baird, Flaherty, and Phylavanh 2003). This being the case, even in the past before there were motorized boats, paddle boats were still generally able to move faster than the fish, especially considering that fish do not always move at the same speed, depending on various factors (Baird, Flaherty, and Phylavanh 2003). Motorized boats can move much faster. The fact that people can stay ahead of the fish makes knowledge transfer about fish migrations important for fishers. For example, one fisher said, 'I usually hear that fish are migrating upstream about five days before the fish actually arrive, which gives me time to prepare.'

Second, access to boat or land transportation – either paddle boats in the past, or motorized boats or motorcycles and other vehicles today – has always been uneven. Those with money are able to access these forms of transportation more than others. Therefore, one's ability to communicate with others over longer distances has long been at least partially dependent on wealth. This is an important political economic factor that will be returned to later.

Information is transferred via people traveling to parties and religious events. Sometimes short-term knowledge about fish migrations is also exchanged when outsiders pass through villages or when there are social events. For example, one interviewee said, 'We always ask guests who pass through the village whether they heard of any fish migrations downstream.' However, one's ability to access social events is not even. First, some people do not have the money to make regular trips to such events. Second, people who are not part of particular social or kinship networks may not be invited to participate. So, again, context matters, as does political economy and networks.

We also heard of situations when fishers would meet in common fishing grounds and discuss the status of fish migrations while 'on the water'. This constitutes a sort of social network, as this information is likely to be exchanged between friends, or at least those who know each other, or have kinship or other links. Therefore, these exchanges of information are uneven and dependent on mobility, but also relationships between people.

In southern Laos, fish traders (buyers and selling dry fish – *pa katao/pa heng*) and tobacco traders were previously important conduits of short-term knowledge about fish migrations. For example, they would travel by boat or vehicle to other communities upriver, and when they arrived there, people would ask them if they had seen fish downstream migrating upstream, and if so when and where. One interviewee said, 'In the past, we [villagers] used to ask people bringing tobacco to sell whether they had heard of any fish migrations downstream.' This information would allow fishers to have a good idea when to expect fish to arrive in their communities.

Along the Mun River in northeastern Thailand, we heard of similar situations where villagers would ask people traveling along the river about the status of fish migrations in order to gain short-term knowledge about fish migrations. In particular, one whetstone seller (used for sharpening knives) previously paddled a boat up and down the river in order to sell his whetstones. He became an important conduit for transferring short-term knowledge about fish migrations between communities.

Short-term knowledge about fish migrations is also transferred through word of mouth, especially in villages when someone hears from others. In other words, even those who do not travel far might learn about fish migrations from their neighbors. Gaining access to information in this way is, however, uneven and dependent on one's connections with certain social networks. For example, if one is well-respected in a community with many people who travel frequently and are well-connected to people in other communities, that person might have better access to information from far away even without having to travel to those places.

It must be acknowledged that fishers could withhold information or provide false information to other fishers in order to prevent other fishers from accessing fish, thus potentially resulting in those withholding information gaining a larger share of the catch, but we did not hear about this happening, and all our informants suggested that information they provided or received was typically reliable. This is likely to be because fishers often provide information to relatives and friends, people who they expect to reciprocate in the future. These social ties are crucial, and lead to higher quality of information exchange.

### ***Distance, time and direction***

We were told that fishers are often able to access information from between 5 to 70 kilometers downstream, depending on various social networks, geographical, and technological factors, including being in a particular country (see below). For example, those living just above the Khone Falls generally only hear about fish migrating upstream when those fish arrive below the Falls, which is also at the Lao border. That is only a distance of five kilometers away, whereas those living on the Mekong River in Pathoumphone District, Champasak Province in Laos may hear about fish migrating up from the Khone Falls, which is about 70 kilometers away. Social networks are clearly important, as are economic ties.

Modern technologies such as motorboats, motorcycles and mobile phones have been particularly important for expanding the distances that people can access information from (see below), and these changes are affecting human mobilities (Berry and Hamilton 2010; Strandell 2014). However, as explained earlier, access to technology is typically uneven, and moreover, it is not the only factor related to gaining access to information. Status in one's own community, and links with other groups of people, are also crucial. ANT can help us to think about different kinds of linkages and technologies.

Fishers often learn about the imminent arrival of migrating fish between 1 to 7 days before the fish actually arrive. Distances that can be accessed, however, have expanded due to transportation and telecommunication technologies. Therefore, people now have more advance warnings about fish migrations. It is not possible to quantify the value of gaining fishers' knowledge from others in terms of being successful fishing, as there are many factors involved, but fishers certainly believe that this is the case, and the time they put into collecting information indicates that fishers believe it is important. One fisher stated, 'Knowing when and where migratory fish are quite advantageous for us.'

One important factor is socio-economic status, or class, with 'middle class' fishers having greater access to the capital needed to access various important forms of technology, including better boats that can travel longer distances in faster times, better mobile phone access, and better fishing gear. Poorer fishers typically have less access to all the above, which makes them less able to develop particular social networks and take advantage of knowledge they collect.

In this study we did not investigate the transfer of knowledge across ethnic and language groups.

### **Communication strategies**

Another new and important technology that has greatly impacted the transfer of short-term knowledge about fish migrations is the mobile or cell phone, which are known for facilitating social networks in the mobilities literature (Rettie 2008), and have been referred to as 'network capital' (Larsen, Axhausen, and Urry 2006). Mobile phones started being used in Thailand in the 1990s, but their arrival in southern Laos and northeastern Cambodia did not come until the 2000s. Since then, usage has increased dramatically. In Southeast Asia, cell phones have become an important part of human mobility and thus can be considered to be part of the 'culture of mobility' (Popov 2012). Moreover, for younger people in mainland Southeast Asia, including in our study area, mobile phones have become an important symbol of youthfulness and modernity (Huijsmans and Lan 2015). Many people told us that they now rely on mobile phones for information about fish migrations. While most communications via mobile phone were about upriver fish migrations, in Cambodia one fisher told us that he also phoned people living upstream from him to ask about how much algae (*thao*) was in the Mekong River, since algae tends to drift downriver, and affects the ability to set gillnets.

As with new and improved transportation technologies, mobile phones have reduced the amount of time, effort and expense associated with obtaining information from far away (Warf 2013). Indeed, they have contributed to what David Harvey (1989) famously referred to as 'time-space compression', a process that effectively brings places closer together through improved transport and communications, and is also linked by him to processes of globalization, and the expansion of capitalism. However, technology is not available to everyone equally, and even when people do have access, technology is not the only important tool when it comes to accessing knowledge (see, for example, Tawil-Souri 2015). Some people claimed that they could not afford a mobile phone, and therefore did not rely on mobile phone communications to gain knowledge about fish migrations. Others we met had mobile phones but rarely phoned long distances, since doing so is expensive, and they claimed to not be able to afford to call far away. Elderly people sometimes reported that they were less familiar or uncomfortable with mobile phone technology than younger people. We can see where ANT and political ecology are needed to consider the complex circumstances.

Besides, even when costs and familiarity are not significant factors, people are also limited to mobile phone-use based on their connections with particular social networks, whether they have strong or weak connections with others (Granovetter 1973; Krackhardt 1992). For example, fishers do not phone people they do not know well, or people who Friedkin (1982) described as having 'weak ties'; as some callers do not know how to present themselves through cellular communications with people they only know a little. Thus, mobile phone communications tend to work better between members of social networks with relatively 'strong ties'.

Thus, in some ways, mobile phones can tend to – at least in certain socio-cultural contexts such as the ones associated with ethnic Lao – focus on strong social networks. Illustrating this, most people we spoke with who gained knowledge about fish migrations via mobile phone communications told us that they mainly contacted close friends, relatives, and people involved in fish trading networks that they were a part of. Therefore, mobile phone access has, if anything, tended to emphasize certain types of social networks (based on strong ties) while underemphasizing or

even weakening others (based on weak ties). This has the potential to significantly change social and political economic contexts over time, including altering the positionality of different actors within society, although it may still be true, as Granovetter (1973) famously pointed out long ago, that social networks based on 'weak ties' can sometimes be more important than 'strong ties', as the former has more potential to have a broader impact, whereas those who have strong ties are more likely to cluster, although it is not always clear what constitutes strong or weak ties (Krackhardt 1992).

### ***Knowledge crossing borders***

We also wanted to know what sorts of boundaries exist to information transfer. Some have already been mentioned above. One important issue relates to international borders between Laos and Cambodia, and Thailand and Laos, even if it is not the main focus of this article. We can consider borders to be technologies of rule (Campbell 2018), ones designed to control space. However, migratory fish all cross these borders without any knowledge about them, thus exhibiting a certain agency that ANT helps us think about. Humans, however, do not always find it easy to cross particular borders, and access can change over time. For example, the border between Laos and Cambodia can be crossed by locals without any documentation. However, in recent years drug smuggling across the border has increased, thus making border crossing more difficult, as government surveillance along the border has increased (Phan 2017; Khmer Times 2016, 2017).

Along the Thailand-Laos border political economic differences still limit some aspects of border-crossing and trade between the two countries (Fernquest 2016), despite plans to open up border trade through the creation of the ASEAN Economic Community (AEC) (ASEAN 2015). The point is that information, people and material transfers across borders are in constant flux, depending on an array of factors.

Mobile phone use is particularly relevant when it comes to flows of short-term knowledge about fish migrations across borders. Indeed, mobile phones have become important for transferring knowledge over space (Warf 2013). Therefore, increased reliance on mobile phones within countries may have actually occurred at the same time as communications across national borders have declined, due to more stringent border controls. But there is a lot of variation.

One thing about mobile phone communications is that they rely on signals coming from cellular towers. Cellular towers are typically, however, limited to communication networks defined by national space, but their signals can travel outside political borders and national space and be picked up, albeit for a limited distance, in neighboring jurisdictions or countries (Tawil-Souri 2015). This has created opportunities for cross-border communications without having to make international telephone calls, which are declining in price but are still expensive for people living in our study area. The 'leaking' of mobile phone transmission signals across borders allow people on both sides of the border, although only those living near the borders, to tap into transmission signals being remitted by towers on the other side of the border, as is the case between China and Myanmar (Baird and Li 2017).

States also use political technologies to limit mobile phone and internet signal transfers across national borders. In relation to the borders between Laos and Cambodia, and Laos and Thailand, if you are in Cambodia or Thailand and located near the borders with Laos, and you have a Lao sim card, you can directly access the Lao mobile phone network from Cambodia or Thailand. As a result, some people in Laos use Cambodian sim cards to phone from the Lao side of the border far into Cambodia to gain knowledge about fish migrations downstream in Cambodia. We also heard of Thai fishers using Thai sim cards to phone fishers on the Lao side of the border who have Thai sim cards in order to ask about fish migrations and also to sell boats and fishing gear to them. In fact, it appears that many people living along both borders have each other's sim cards. Moreover, most mobile phones can now accommodate two sim cards, so users can easily switch from one network to another. However, it appears that Cambodians tend to have Lao sim cards

more than Lao people have Cambodian sim cards. This is apparently because Lao people are under the impression that Cambodian phone time is more expensive than phone time in Laos. Similarly, on the Thailand-Laos border, Lao people tend to have Thai sim cards more than Thai people have Lao sim cards. International borders are limiting the transfer of knowledge about fish migrations in some ways, but people living in close vicinity to the border can often access telephone signals on both sides of the border, thus opening up particular opportunities for them to engage in cross-border communications and create and maintain social networks across borders through the use of mobile phones, even though actual human border crossing is not always easy. Moreover, the governments of Laos and Thailand have apparently politically agreed to limit the reach of mobile phone signals into one another's territory, as Lao mobile service providers have been negatively affected by strong signals from service operators in Thailand. In 2013, DTAC – Thailand's second largest mobile service provider – agreed to reduce its signal strength along the border to reduce signal interference in Laos. On the government to government level, Laos and Thailand have agreed that their mobile signals shall not extend more than one kilometer inside populated border areas, and two kilometers in less populated areas. The signal level from another country in border areas is capped at  $-90\text{dBm}$  (decibel-milliwatt, an electrical power unit measured in decibels) for 2G technology and  $-100\text{dBm}$  for 3G. In late 2017 the Ministry of Post and Telecommunications in Laos also announced measures to ensure that people in Laos remove devices that access internet services in Thailand from as far as ten kilometers from the border (Souksakhone 2017). Both ANT and political economy are useful to consider in relation to mobile phone technologies.

Thus, those living near borders and within range of cellular towers in adjacent countries still have a distinct advantage over those living farther from the border, in that they are able to communicate with people in the adjacent country using a mobile phone, but there is the potential for change soon, as people increasingly adopt Smart phones that provide internet access. This is crucial as it will give users access to Voice Over Internet Protocol (VOIP), telephone communications that are entirely through cyberspace, such as Line, Facebook, and Skype (Warf 2013). This effectively eliminates the high cost of long-distance cross-border calls, and makes it as easy for people far away from the border to contact people across the border as compared to those living near the border. Even with increased technological power, however, this may not be useful if the people who use the technology are not well connected to social networks. Nation states may also increasingly control signals across national borders. For now, however, most people in Laos and Thailand who engage in cross-border communications mainly use regular mobile phones, although this is beginning to shift, and we can expect the geographies associated with mobile phone communications across borders to change substantially in the future.

### ***The Pak Mun dam – changing flows of knowledge***

Another important barrier to the transfer of knowledge about fish migrations is the construction of hydropower dams, as they can block fish migrations and boat movements. The Pak Mun dam, which is located on the Mun River in Ubon Ratchathani Province, northeastern Thailand, just seven kilometers upstream from where the Mun River flows in the Mekong River, is a good example of this. Its construction was completed in 1994, and since then the dam has become well-known for blocking major fish migrations from the Mekong River (Roberts 1993, 2001; Amornsakchai et al. 2000; Jutagate et al. 2003, 2005; Foran and Manorom 2009). While a fish ladder was added to the dam late in the dam's design period, various studies have determined that only a small portion of fish pass the Pak Mun dam using the fish ladder (Sripatprasit 2005; Roberts 2001).

The Pak Mun dam has impacted the transfer of short-term *fishers' situated knowledge* about fish migrations in significant ways. The Pak Mun dam has physically made river transportation up and down the Mun River much more difficult, as boats cannot traverse the dam when it is closed. It has also blocked fish migrations, thus affecting knowledge transfer.

More importantly, however, people above and below the Pak Mun dam do not communicate about fish migrations as much as before, as they report having little reason to do so, since fish do not pass the part of the river where the Pak Mun dam is located in large quantities like they used to. Here we see how ANT is effective in linking different important actors together. Therefore, people would typically not phone from upstream villages to those living below the dam to ask if the fish were migrating up there, as they might have before the dam was built; and even if they learned that the fish were migrating upriver, it would not do them much good, as the fish would not reach them anyway. Political ecology is useful for understanding capitalist development processes and their environmental impacts. The blocking of fish migrations has also obstructed the flow of knowledge, and has resulted in the weakening or severing of social and trade networks that previously existed between upstream and downstream individuals and communities. However, there is one exception to this. When people upstream want to catch fish just below the dam, they sometimes phone people living just downstream from the dam to ask if the dam has been opened yet or not. If the sluice gates have been opened, there is no reason for them to travel to below the dam to catch fish, as the fish will be able to migrate upstream, and will not be concentrated just below the dam, but if the dam's gates have not been opened, then fishers may need to travel to the dam site to fish for blocked fish concentrated just downriver from the dam. Indeed, knowledge is still being transferred over space, but in different ways, and for new reasons.

## Conclusions

So what lessons can we draw from the above results? First, we need to think of knowledge as something that is in some ways place-based, but is not spatially static. It is frequently transferred and is affected by various actors, including humans, social networks, fish and technologies. This is where ANT helps us, as ANT makes a place for non-human actors, such as fish, and also technologies used to catch them, but also for other 'things'.

Second, the mobile knowledge that we have discussed is all situated, as its transfer and acquisition is based on various factors, including the networks that humans belong to and their socio-economic status. Knowledge transfer also, however, depends on other creatures, such as birds. We need to recognize the roles of non-humans, and bring them and knowledge flows more squarely into the literature on mobilities, something that has always been intended, but has occurred less commonly.

Third, and crucially, there are new technologies that facilitate the communication of knowledge across space and time, such as motorized boats, motorcycles, and mobile phones. Some of these can, at least to a certain degree, transcend international borders. However, borders and other barriers such as dams can interrupt and even obstruct the flow of knowledge. Fishers, however, still share some fish migration knowledge related to the dam's operations, including the closing and opening of its sluice gates. Political ecology is best suited for considering the ecological impacts of such capitalist development initiatives.

Fourth, fishers' situated knowledge, which is always located in particular contexts, is at least partially dependent on geographical spaces, due to various ecological and social factors, but it also depends on various other political and networking factors associated with fishers' involvement in social networks (see, also, Mueller et al. 2008; Rosas et al. 2014; Turner, Polunin, and Stead 2014). Indeed, there are various forms of knowledge – long-term or generational and short-term – and they depend on different situated contexts. Long-term or generational networks often require the verbal transfer of knowledge at particular places. Short-term knowledge, such as information about when fish are about to come upriver, is much more reliant on social networks.

## Acknowledgments

Thanks to all the fishers living near the Mun River in northeastern Thailand, the Mekong River in southern Laos, and the Mekong, Sekong and Sesan Rivers in northeastern Cambodia for sharing knowledge with us. Without them this

study would not have been possible. The research that led to this paper was funded by the project “Tracking Change - The Role of Local and Traditional Knowledge in Watershed Governance”, which is administered by the University of Alberta, and funded by the Social Sciences and Humanities Research Council (SSHRC) of Canada. Thanks to Brenda Parlee, Louis and Boriphath Lebel, Brian McIntosh and two anonymous reviewers for commenting on earlier versions of this paper.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work was supported by the Social Sciences and Humanities Research Council of Canada [SSHRC 895-2015-1024].

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