Decline in the Abundance of Fish in the Main Tributaries of the Mekong River in Upper Northeastern Thailand

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ABSTRACT The aim of this study was to analyze the abundance of migrating fishes in two Mekong River tributaries, the Hauyluang and Songkhram Rivers, located in the upper northeastern part of Thailand. Local fishery techniques were used for the sampling, which consisted of locally obtained fishing gear, hooks, bamboo basket traps, lift nets, long fishing net traps and fishnets. The study was performed on 48 fish species which migrated between the Mekong River and its tributaries, the Hauyluang and Songkhram rivers. The results showed that 23 fish species in both tributaries decreased in number over four years of sampling. About seven species increased in their abundance and higher individual catches were found. This result suggested that 17 and 22 fish species from Hauyluang and Songkhram Rivers, respectively, declined in number. There were five and four species from the Hauyluang and Songkhram Rivers, respectively that increased in abundance. Other fish species were not significantly different in their abundance during sampling years. However, long term study is needed to draw more accurate conclusions. Additionally, abundance among the species followed a similar pattern in both tributaries. These results confirmed the previous reports of conditions that threaten species diversity and abundance of the Mekong and its tributaries in the Lower Mekong Basin. The problems that occurred in these two tributaries were very similar, being linked to dams in the Mekong, water gates in the two tributaries and recent drought conditions.

1. INTRODUCTION

The Mekong River is the largest river in Southeast Asia. It covers a distance of more than 7000 km and flows through six countries before reaching the sea. The Mekong is notable for its freshwater fish diversity and fisheries. The current estimate is that the river basin is inhabited by more than 1200 fish species. The river basin's inland capture fisheries are exceptionally important and probably the largest inland capture fishery the world. More than 60 million people depend on these fishery resources for income and food (Baran and Myschowoda, 2009). The Mekong River covers a distance of about 800 km as it flows through six provinces in Northeastern Thailand and it is the border between Thailand and Laos. About 4.5 million rural people (about 700000 households) live in the basin area of upper Northeast Thailand, and about 42% live and rely directly on the two tributary systems, i.e., the Hauyluang and Songkhram Rivers, for their food security and livelihoods. Most of these households would be affected by changes in fish availability, as fish is the main source of dietary protein (Orr et al., 2012). Preliminary production estimates for the Hauyluang and Songkhram Rivers are about 100,000 tonnes of fish a year which provides about 27 kg per person (Kaensa, 2016, *in press*). The per capita freshwater fish consumption of the Lower Mekong Basin was estimated to be 33.7 kg/person/yr for each of the 60 million people in the basin (Hortle, 2007).

Fish diversity and abundance are maintained in the Mekong and its tributaries via migration. Fish migrations are an important feature of river ecology in most major tropical rivers. Often fishes migrate several hundred km to reach spawning sites or fertile feeding grounds. These long-distance migrations within main river channels and their tributaries are normally referred to as longitudinal migrations. Lateral migration is when fish migrate from a main river and its tributaries onto floodplain areas during the flooding season and back again during the dry season. In the Mekong, fish migrations have great implications for fisheries because a substantial part of the fisheries are based on catching migrating fish (Baran and Myschowoda, 2009). The fish catch in the Mekong and the two tributaries is said to have considerably declined over the past years. The current research was to test this hypothesis for the Hauyluang and Songkhram Rivers at a time when the area faces several threats.

2. EXPERIMENT

2.1 Survey method

This fish abundance survey was carried out over four years from February 2012 to March 2015. A total of 5 sites were sampled on each of Hauyluang and Songkhram Rivers. The sampling sites included floodplains outside the main channels of both rivers. All sites were surveyed three times a year (sampling was conducted at the same time each year) and over the three seasons of the area (dry, rainy and summer). The sampling techniques followed the procedures for monitoring fish diversity of Thai Baan Research (2006). This is participatory resource research that involves community-based documentation of the local resources and their importance to village livelihoods. Knowledge of resource use and ecology, including trends and historical resource quality was consolidated considering six issues: fish, fishing gear, local vegetation, agriculture and gardens, cattle and buffaloes, and the local ecosystems. Participatory researchers for fish survey were local villagers and fishermen in each sampling site. Local fishery techniques were used for the sampling which consisted of locally obtained fishing gear, fishing hooks, bamboo basket traps, lift nets, long fishing net traps and fishnets. Classification and taxonomic nomenclature followed Rainboth (1996), Vidthayanon (2008). The specimens were deposited, together with related documents, in the Zoological Laboratory, Department of Biology, Faculty of Science, Udon Thani Rajabaht University, Thailand.

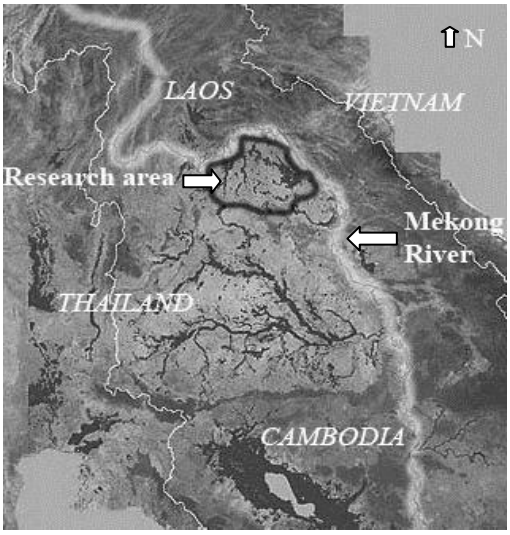

Fig. 1 Research areas on the Hauyluang and Songkhram Rivers in Upper Northeastern Thailand. (Edited from UN University Project, 2005)

2.2 Statistical analysis

Since different fishing gear was used at the various sampling sites, patterns of richness and abundance in the study areas were compared using an individual-based curve. To derive variables for each river, detection data from all fishing gear types and all sampling sites were aggregated. Abundance of each species was derived using the formula:

$$\frac{\text{Individual number of any species or total weight of any species}}{\text{Total individual number of all species or total weight of all species}}$$

We used abundance-based estimators, the classic Chao 1 and ACE, which are recommended as robust abundance estimators, EstimateS 8.2. To compare abundance and composition among sampling sites and the rivers, we derived Chao-Jaccard Similarity Index (JSI) using EstimateS 8.2 (Colwell, 2008). To compare the differences in abundance and individual catch rates with respect to sampling sites, years and seasons, we compared data using two-sample t-tests, one-way ANOVA and the multiple comparisons Tukey test. Statistical tests were conducted using the R statistical program, Version 2.15.1 (Kaensa, 2016, *in press*)

3. RESULTS & DISCUSSIONS

A total of 7424 individuals and 2007 kg (72 fish species) were collected. There were 3323 catches consisting of 847 kg (63 species) in the Hauyluang and 4101 catches and 1160 kg (70 species) in the Songkhram. In the current study, we found 60 species were common to both rivers. The study was performed on 48 of these common fish species (Table 1) which clearly migrated between the Mekong and its tributaries, the Hauyluang and Songkhram Rivers as well as other rivers in Northeastern Thailand (Sokheng et al., 1999). The results showed that 23 fish species from both tributaries decreased in abundance and there was a lower number of individual catches found during the four years of sampling. About seven species increased in their abundance and higher individual catches were found. However, 18 species neither increased nor decreased significantly. The results suggested that 17 and 22 fish species from Hauyluang and Songkhram Rivers, respectively, declined in their abundance. There were five and four species from Hauyluang and Songkhram, respectively, that increased in abundance (Table 1). Other fish species were not significantly different in their abundance during the sampling years. Additionally, abundance among species followed a similar pattern in each survey year in both tributary rivers.

The fish catch in these two tributaries is said to have considerably declined after construction of water gates near the estuaries of the both rivers. The water gates were opened in 2008 and 2011 for the Hauyluang and Songkhram Rivers, respectively. A number of studies have found that the dams and water gates positively affect agriculture and provide hydropower, but they also negatively impact other sectors relying on river flows such as fisheries (Baran and Myschowoda, 2009; Orr et al., 2012). The water gates are closed late in the dry season to the mid-rainy season. These are the periods of

maximum fish migration (long-distance and lateral migrations) in the Mekong and its tributaries for feeding and spawning. The most obvious problem is simply the loss of connectivity between natural environments. The physical presence of dams and water gates on the Mekong and its tributaries blocks the migration routes used by fish and therefore prevents them from completing their natural lifecycle (Orr et al., 2012).

Table 1 Species list and its tendency of abundance (List of abbreviation, tend. ab. = tendency of abundance, 1= Hauyluang River, 2= Songkhram River, de = decreasing abundance, in = increasing abundance, and - = non-significant change)

Families	Species	tend. ab.	
		1	2
Bagridae	*Bagrichthys majusculus*	de	de
	Pseudomystus siamensis	de	de
	Mystus albolineatus	-	-
	Mystus bocourti	-	-
	Mystus singaringan	de	de
	Hemibagrus spilopterus	-	de
	Hemibagrus wyckioides	-	de
Cichlidae	*Oreochromis niloticus*	-	-
Clupeidae	*Clupeichthys aesarnensis*	-	in
	Hilsa kelee	in	in
Cyprinidae	*Paralaubuca barroni*	de	-
	Paralaubuca typus	de	de
	Parachela siamensis	-	-
	Raiamas guttatus	de	de
	Probarbus jullieni	de	de
	Amblyrhynchichthys micracanthus	-	-
	Cosmochilus harmandi	de	de
	Cyclocheilichthys armatus	-	-
	Cyclocheilichthys repasson	-	-
	Cyclocheilos enoplos	de	de
	Cyclocheilos furcatus	-	de
	Puntioplites falcifer	-	-
	Puntioplites proctozystron	-	-
	Sikukia gudgeri	in	-
	Barbonymus altus	-	-
	Borbonymus gonionotus	-	-
	Hypsibarbus malcolmi	-	-
	Hypsibarbus suvattii	-	-
	Scaphognathops bandanensis	-	de
	Thynnichthys thynnoides	in	in
	Gymnostomus siamensis	-	in
	Gymnostomus ornatipinnis	-	-
	Labiobarbus leptocheilus	de	de
	Labeo chrysophekdion	-	de
	Osteochilus vittatus	de	de
	Osteochilus lini	in	-
	Epalzeorhynchos frenatus	-	-
Notopteridae	*Chitala ornata*	-	de
Osphronemidae	*Trichopodus trichopterus*	de	de
Pangasiidae	*Helicophagus leptorhynchus*	-	-
	Pangasius conchophilus	de	de
	Pangasius macronema	de	de
Pristolepididae	*Pristolepis fasciata*	de	de
Siluridae	*Kryptopterus cheveyi*	de	-
	Krypterus geminus	-	-
	Ompok siluroides	in	-
	Phalacronotus bleekeri	-	de
	Phalaceonotus micronrmus	de	de

4. CONCLUSION

From the results, it can be seen that many species of migrating fish in the Hauyluang and Songkhram Rivers showed significantly decreasing abundance over the survey years. Since this study is a short term survey, it is not known if this result is a serious problem or just a normal fluctuation. In the Hauyluang and Songkhram Rivers, where fish abundance depends directly on fish migration between upstream, downstream habitats and the Mekong River, the water gates located near estuaries may have most significant impacts.

However, long term study is needed for more accurate conclusions. These results confirmed that previous reports declining fishery resources and species diversity along the Mekong and its tributaries in the Lower Mekong Basin. The problems that occurred in these two tributaries were very similar and attributable to dams in the Mekong, water gates in the two tributaries and drought conditions.

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