NAT. HIST. BULL. SIAM. SOC. 57: 3–18, 2011

SEASONAL OCCURRENCES OF LARVAL, JUVENILE AND YOUNG FISHES IN THE FLOODPLAIN OF A MEKONG TRIBUTARY, LAO P.D.R.

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ABSTRACT

We studied the seasonal occurrences of larval and juvenile fishes in floodplain habitats of a tributary of the Mekong River in Lao P.D.R., by seining the center of a floodplain lake, its inundated area, its shoreline, and the littoral zone of the river, from March (the end of the dry season) to August (the middle of the wet season) 2006. We collected 2,084 individual larval and juvenile fishes representing seven orders, 13 families, and at least 32 species. Twenty-nine species occurred in the floodplain. Of these, 28 species occurred in the temporal waters (inundated area and shoreline). Nine species occurred in the littoral zone of the river. The mean catch per unit effort (CPUE) of juveniles in the temporal water was 7.3 to 14.5 times that of the permanent water (the center of a floodplain lake) in the middle of the wet season. Many larval and juvenile fishes were observed in the early part and the middle of the wet season. The dominant species changed dramatically among seasons. The temporary waters of the floodplain were considered important nursery grounds for both floodplain and riverine fishes. The littoral zone of the river was used by a limited number of species in the early wet season; however, after the water level fell it seemed to become an important nursery ground for species whose juveniles grew in the floodplain. The habitat use patterns and spawning triggers for the nine dominant species and an additional four species were discussed.

Keywords: juvenile fish, floodplain, Lao P.D.R., larvae, Mekong River, temporary water

INTRODUCTION

Documented records exist for approximately 700 fish species in the Mekong basin (KOTTELAT, 2001), which ranks as the second river in the world (after the Amazon) in terms of fish biodiversity. Various fish species migrate from the Mekong and its tributaries to floodplains for spawning, rearing, and foraging during the wet season (POULSON, 2000). The importance of the floodplains as a nursery ground has been recognized from local ecological knowledge (POULSON, 2000; BAO *ET AL*., 2001), high food availability (TAKI, 1978; BAIRD, 2007), and the habitat use patterns of some fish species (IWATA *ET AL*., 2003). Nevertheless, almost no information is available regarding the seasonal occurrence of larval and juvenile fishes in the floodplains.

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Received 25 January 2008; accepted 24 April 2009.

The Mekong floodplains are severely affected by human activities. Concerns have been raised regarding degradation of the natural environment due to altered hydrology from dam construction and irrigation (DUDGEON, 2000; TOCKNER & STANFORD, 2002; MEKONG RIVER COMMISSION, 2003; BAIRD, 2007). Therefore, understanding the seasonal dynamics of larval and juvenile fishes is important for reliably predicting the effects of altered seasonal hydrology.

The purpose of this study was to clarify the seasonal occurrences of larval and juvenile fishes in the floodplain of a Mekong tributary, Lao P.D.R. We also discuss the seasonal roles of the floodplains and littoral zones of the river as nursery grounds, and consider habitat use patterns and spawning triggers of the dominant species.

MATERIALS AND METHODS

Study Site

This study was conducted downstream of the Champhon River (Fig. 1–3) from March to August, 2006. The study site was situated at 16°24´N, 105°11´E. The Champhon River is located in the southern part of Lao P.D.R. and flows south to the Banhiang River, one of the main tributaries of the Mekong. The distance from the mouth of the Champhon to the Mekong is about 70 km, and there are 240 km^2 of wetlands in the Champhon basin (CLARIDGE, 1996). IWATA *ET AL*. (2003) surveyed the fish fauna of the Banhiang River system, including the Champhon River, and stated that the fish fauna of this area comprised ten orders, 31 families, and approximately 158 species (57.6% Cypriniformes, 16.5% Siluriformes, and 12.7% Perciformes).

The seasonal water level fluctuations of the Champhon River are quite large, with a mean variation of approximately 7 m (1 to 8 m) per year (Fig. 2 and 3). In the wet season, the water level of the Champhon River rises sharply around June and July, creating connections with floodplain lakes (Fig. 4). In 2006, the first water rise occurred from 1 to 5 July (1.3 to 7.5 m, Fig. 5). For assessment of seasonal water fluctuations, we divided the study period into three seasons, and established seven sampling sites along a transect from the river to the floodplain, covering four environments as follows (Fig. 1). (1) The littoral zone of the river: the area was within 2 m from the riverbank (site 1). (2) The center of a floodplain lake: the area retaining water body during the dry season, and connected to the river by overflow of the river during the middle of the wet season (site 2). (3) The inundated area: the area with temporary water 10 to 30 m from the shore of the lake (site 4 and 6). (4) The shoreline: the area with temporary water within 2 m of the shore of the floodplain lake, bounded by rice fields (site 3, 5 and 7; Fig. 4).

The dry season (6 March to 2 May, 2006) experienced the lowest water levels among all seasons. The sampling sites were the littoral zone of the river (site 1, 0.5 m water depth), the center of a floodplain lake (site 2, 1 m), and the shoreline (site 3, 0.3 m). Each site was sampled twice per season.

During the early wet season (16 May to 21 June, 2006), the water levels of the floodplain lake increased because of rainfall, and the areas around the floodplain lake were inundated. The river was not yet connected to the floodplain lakes. The sampling sites were the littoral zone of the river (site 1, 0.5–1 m), the center of a floodplain lake (site

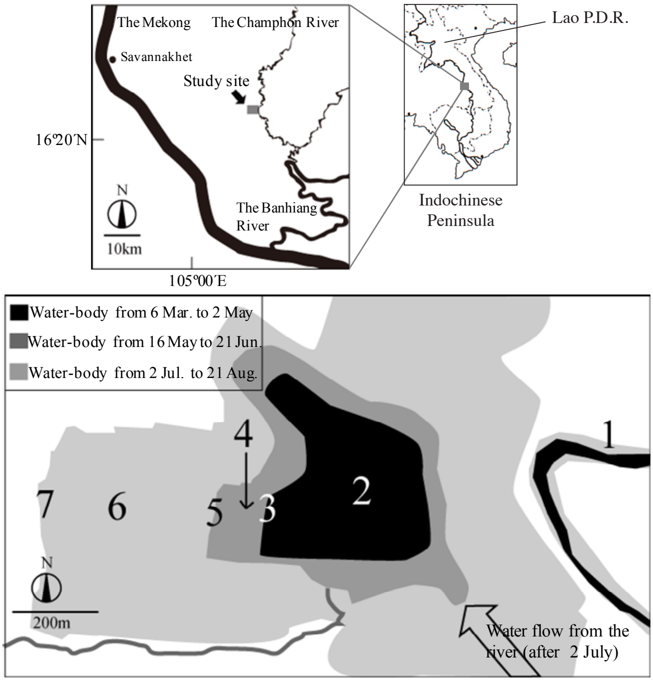

Figure 1. Location of study site (above) and position of sampling sites 1–7 and seasonal changes of water-body from March to August 2006 (below).

Figure 2. The Champhon River of the dry season (25 February 2006, 0.9 m water depth).

Figure 3. The Champhon River in the middle of the wet season (1 September 2005, 7.4 m).

Figure 4. The floodplain lake and adjacent the ricefield during the middle wet season.

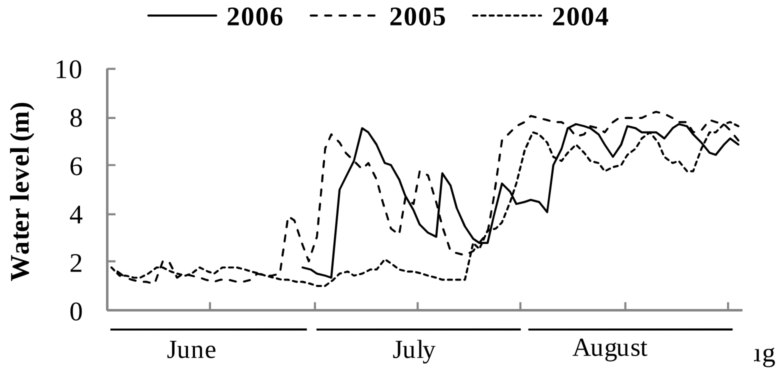

Figure 5. Water level of the Champhon river from June to August in 2004, 2005, and 2006, provided by the Agriculture and Forestry Office, Champhon district, Savannakhet province. (Data from 1 to 26 June 2006 were not available).

2, 1–1.5 m), the inundated area (site 4, 0.7 m), and the shoreline (site 5, 0.3 m). The littoral zone of the river was sampled four times; the other sites were sampled six times during this season.

During the middle of the wet season (2 July to 21 August, 2006) the water level of the river rose sharply, and the river became connected to the floodplain lake. Large areas of the floodplain were inundated. The sampling sites included the littoral zone of the river (site 1, 0.5–1 m), the center of a floodplain lake (site 2, 3–4 m), the inundated area (site 6, 1–1.5 m), and the shoreline (site 7, 0.3 m). The littoral zone of the river was sampled twice, the center of a floodplain lake and the shoreline were sampled five times, and the inundated area was sampled four times during the season.

Sampling Methods

All fish samples were collected using a small seine net (0.9 × 1.8 m, 1-mm mesh) during the daytime. The net was drawn by hand at sampling sites 1–5. At sites 6 and 7, the net was pulled by a boat equipped with an engine because of the deeper water. We calculated catch per unit effort (CPUE) as the number of individuals per 20 m of seining. The center of a floodplain lake, the inundated area, and the shoreline were sampled on the same day in each season, but on 8 July the inundated area was not sampled. Collected fishes were immediately fixed in 5% formalin. Specimens were deposited in the Faculty of Agriculture, National University of Laos. Most fish samples were identified by reference to RAINBOTH (1996), KOTTELAT (2001), and TERMVIDCHAKON (2003). The species names followed KOTTELAT (2001). Morphological observations were made using a microscope (MZ-8R-LS: LEICA). Developmental stage classification (yolk-sac larvae, post larvae, and juvenile) followed OKIYAMA (1988), and young was defined as developmental stage which is more growth than juvenile, but obviously smaller than the adult fish's size. Identification of juveniles was followed series method of LEIS & TRNSKI (1989). Spp. (plural abbreviation for species) means some species within a genus, but in this study spp. was counted as one species.

RESULTS

Species Composition

We collected 2,084 individual larval and juvenile fishes, including specimens from seven orders, 13 families, and at least 33 species. Twenty-nine species occurred in the floodplain. Of these, 28 species occurred in the temporal waters of the floodplain (the inundated area and the shoreline). Nine species occurred in the littoral zone of the river. The catch percentages for each species collected are shown in Table 1. *Gobiopterus chuno* was the most common species, accounting for 28.3% of the total abundance. *Parambassis siamensis* (15.3%) was ranked second, followed by *Parachela* spp. (10.1%), *Puntius brevis* (10.0%), *Rasbora rubrodorsalis* (7.3%), *Rasbora borapetensis* (6.7%), *Clupeichthys aesarnensis* (4.7%), *Henicorhynchus ornatipinnis* (4.4%), and *Henicorhynchus siamensis* (2.9%). These top nine dominant species accounted for 89.8% of the total abundance.

Table 1. Larval and juvenile fishes shown by percentages of individual numbers collected from all sampling sites between 6 March and 21 August 2006.

Species name	**%**	**Species name**	**%**
Notopteridae		Balitoridae	
Notopterus notopterus	0.05	*Nemacheilus* sp.	0.05
Clupeidae		Cobitidae	
Clupeichthys aesarnensis	4.72	*Acanthopsoides* sp.	0.03
Cyprinidae		Siluridae	
Cyclocheilichthys spp.	0.30	*Kryptopterus* sp.	0.01
Cyclocheilichthys repasson	0.99	Adrianichthyidae	
Esomus metallicus	1.98	*Oryzias* sp.	0.41
Hampala dispar	0.74	Belonidae	
Henicorhynchus ornatipinnis	4.38	*Xenentodon canciloides*	0.10
Henicorhynchus siamensis	2.94	Mastacembelidae	
Labiobarbus sp.	0.03	*Macrognathus siamensis*	0.06
Mystacoleucus spp.	1.62	Chandidae	
Opsarius koratensis	+	*Parambassis siamensis*	15.34
Osteochilus spp.	0.06	Pristolepididae	
Parachela spp.	10.10	*Pristolepis fasciata*	0.43
Paralaubuca spp.	0.22	Gobiidae	
Puntius brevis	9.98	*Brachygobius mekongensis*	0.48
Rasbora aurotaenia	0.55	*Gobiopterus chuno*	28.33
Rasbora borapetensis	6.69	Osphronemidae	
Rasbora rubrodorsalis	7.33	*Trichopsis schalleri*	1.12
Rasbora trilineata	0.01	Unidentified larvae	0.08
Rasbora sp.	0.58		
Thynnichthys thynnoides	0.29		

(+) less than 0.005%.

Table 2. List of mean CPUEs for larval and juvenile fishes and number of species collected in the littoral zone of the river, the center of a floodplain lake, the inundated area, and the shoreline.

Species name	Littoral zone of the river					Center of a floodplain lake					Inundated area				Shoreline				
	D	EW		MW		D	EW		MW		EW		MW		D	EW		MW	
	J	L	J	L	J	J	L	J	L	J	L	J	L	J	J	L	J	L	J
Notopterus notopterus																	0.17		
Clupeichthys aesarnensis		0.17	1.13		0.67			1.50	0.28	4.69			2.58	12.67				0.27	0.93
Cyclocheilichthys spp.														0.08					
Cyclocheilichthys repasson							0.50	0.50			0.17	1.17		1.08			1.00		0.67
Esomus metallicus														0.17	0.50		0.50		7.30
Hampala dispar												0.17					2.33		0.10
Henicorhynchus ornatipinnis								0.50				8.17	0.33	0.42			5.33		0.83
Henicorhynchus siamensis			0.63		0.14					0.06				9.17					4.67
Labiobarbus sp.																			0.13
Mystacoleucus spp.		1.58	6.63		0.43														
Opsarius koratensis										0.03									
Osteochilus spp.																			0.27
Parachela spp.					0.14			3		0.03	1.17	10.83	0.17	3.58		9.00	4.50	0.27	4.53
Paralaubuca spp.														1.00					0.10
Puntius brevis							0.17				0.33	24.17				0.17	9.83		
Rasbora aurotaenia										0.03				2.17					0.53
Rasbora borapetensis						0.50					0.17	9.50		0.25			11.00		2.70
Rasbora rubrodorsalis																			30.53
Rasbora trilineata														0.08					
Rasbora sp.					0.33														2.27
Thynnichthys thynnoides														1.50					
Acanthopsoides sp.					0.33														
Nemacheilus sp.					0.57														

Table 2 (continued)

Species name	Littoral zone of the river					Center of a floodplain lake					Inundated area				Shoreline				
	D	EW		MW		D	EW		MW		EW		MW		D	EW		MW	
	J	L	J	L	J	J	L	J	L	J	L	J	L	J	J	L	J	L	J
Kryptopterus sp.														0.08					
Oryzias sp.																			1.70
Xenentodon canciloides																		0.13	0.27
Macrognathus siamensis												0.17		0.08					
Parambassis siamensis		2.13	1.25		0.14		0.67	7.33		0.16	3.50	16.32		3.33		2.17	10.83		9.33
Pristolepis fasciata												1.33					0.17		
Brachygobius mekongensis											0.17					0.33	1.17		
Gobiopterus chuno			0.46				1.33	6.83			10.83	25.50		0.46	0.50	29.67	23.00		0.50
Trichopsis schalleri																			4.67
Unidentified larvae													0.25					0.13	
Mean CPUE	0	3.87	10.08	0	2.76	0.50	2.67	19.67	0.28	4.99	16.33	97.33	2.92	36.37	1.00	41.33	69.83	0.80	72.17
Number of species	0	3	5	0	8	1	4	6	1	6	7	10	3	16	2	5	12	3	19

D, the dry season (6 Mar. to 2 May); EW, the early wet season (16 May to 21 Jun.), MW, the middle of the wet season (2 Jul. to 21 Aug.); L, larva; J, juvenile.

Seasonal Changes

Table 2 lists mean CPUEs for larval and juvenile fishes and number of species collected in the littoral zone of the river, the center of a floodplain lake, the inundated area, and the shoreline. Seasonal changes in the numbers of individuals and species of larval and juvenile fishes collected in the floodplain (including the center of a floodplain lake, the inundated area, and the shoreline) and the littoral zone of the river are shown in Fig. 6.

Floodplain

During the dry season, only three individuals were collected. In the early wet season, the number of individuals increased after 16 May 2006 with a peak observed on 8 June followed by declining numbers until 21 June. The peak in the number of species was observed on 15 June 2006. The highest mean CPUE for juveniles was 97.33 s in the inundated area, and the highest value for larvae was 41.33 along the shoreline. The mean CPUE for juveniles in the temporal waters was 3.6 to 4.9 times that of the permanent water (the center of a floodplain lake).

During the middle of the wet season, the number of individuals was low in early July 2006, increased after 30 July, and peaked on 17 August. The number of species remained high from the end of July into August. Fourteen species were first detected on the floodplain during this season. The highest mean CPUE for juveniles was 72.17 along the shoreline, and the highest value for larvae was 2.92 in the inundated area. The mean CPUE for juveniles in the temporal waters of the floodplain was 7.3 to 14.5 times that of the permanent water.

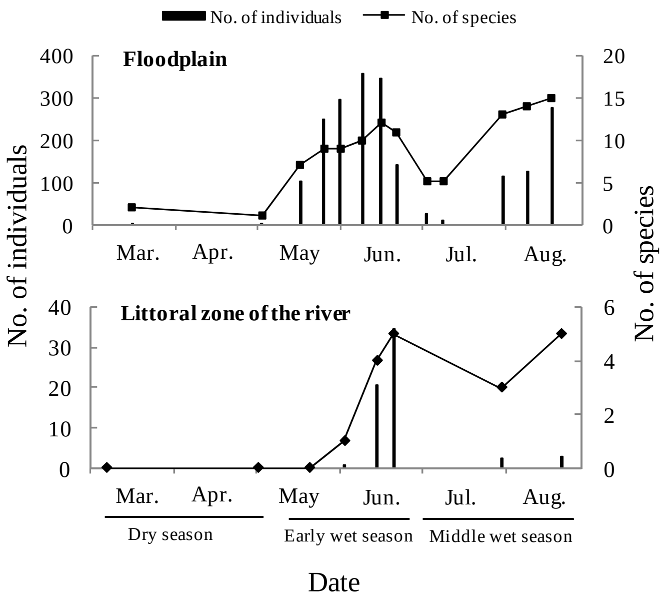

Figure 6. Seasonal changes in the numbers of individuals and species of larval and juvenile fishes collected in the floodplain and the littoral zone of the river.

Littoral zone of the river

In the dry season, larval and juvenile fishes were not collected. During the early wet season, 21 individuals and 35 individuals were collected on 14 June and 20 June 2006, respectively. On all other days, almost no larval or juvenile fishes were collected. Juveniles of *Mystacoleucus* spp. accounted for 65.8% of all juveniles sampled in the littoral zone of the river in this season; *Parambassis siamensis* (12.4%) ranked second.

During the middle wet season, the number of individuals was low, but many young fishes were collected on 21 August 2006 (Table 3). Juveniles of two species (*Parachela* spp. and *Nemacheilus* sp.) and young fishes of eight species (*Crossocheilus reticulatus*, *Labiobarbus* sp., *Opsarius koratensis, Osteocheilus waandersi, Parachela* spp., *Paralaubuca* spp., *Rasbora aurotaenia,* and *Nemacheilus* sp.) were sampled for the first time in the littoral zone of the river during the study period. Body size of young fishes was close to that of juveniles.

Dominant species of the floodplain

Seasonal changes in the relative abundances of dominant species collected in the floodplain from 16 May to 17 August 2006 are shown in Fig. 7. *Gobiopterus chuno*, *Parambassis siamensis*, *Puntius brevis*, *Parachela* spp., *Rasbora borapetensis*, and *Henicorhynchus ornatipinnis* were dominant species in the early wet season. *Clupeichthys aesarnensis, Henicorhynchus siamensis, Rasbora rubrodorsalis, Parachela* spp., *R. borapetensis*, and *P. siamensis* were dominant species in the middle wet season.

Seasonal changes in CPUEs of the top nine dominant larval and juvenile fishes in the center of a floodplain lake, the inundated area, and the shoreline are shown in Fig. 8.

Table 3. Number of fishes collected by 50 m of seining in the littoral zone of the river on 21 August 2006.

Species name	Juvenile	Young	Adult
Clupeichthys aesarnensis		7	2
Crossocheilus reticulatus		3	
Henicorhynchus siamensis	1		
Labiobarbus sp.		2	
Mystacoleucus spp.	3		
Opsarius koratensis		24	
Osteochilus waandersii		1	
Parachela spp.	1	1	
Paralaubuca spp.		1	
Rasbora aurotaenia		18	
Acanthopsoides sp.		1	1
Botia morleti			2
Nemacheilus sp.	4	2	2
Pangio sp.			32
Parambassis siamensis	1	15	2
Gobiopterus chuno		1	

Gobiopterus chuno, *Puntius brevis*, and *Henicorhynchus ornatipinnis* mainly occurred in the early wet season. *Clupeichthys aesarnensis* and *Henicorhynchus siamensis* mainly occurred in the middle wet season. *Parambassis siamensis*, *Parachela* spp., and *Rasbora borapetensis* were collected from the early wet season to the middle wet season. *Rasbora rubrodorsalis* was only encountered on 17 August 2006.

Developmental Stages

Juveniles of 32 species were sampled, but larvae of only 12 species were sampled, and larval abundances were relatively low compared to juveniles (Table 2). The larvae collected were all in the post larvae.

The relative abundances of larvae and juveniles of the three dominant species (*Gobiopterus chuno*, *Parambassis siamensis*, and *Parachela* spp.) in the inundated area and the shoreline in the early wet season are shown in Fig. 9. The larvae of *G. chuno* and *Parachela* spp. accounted for 71.4% and 88.5% of the shoreline abundance, respectively. Juveniles of *G. chuno* and *Parachela* spp. accounted for 45.4% and 29.4% of the shoreline abundance, respectively. Larvae and juveniles of *P. siamensis* occurred at nearly the same rate.

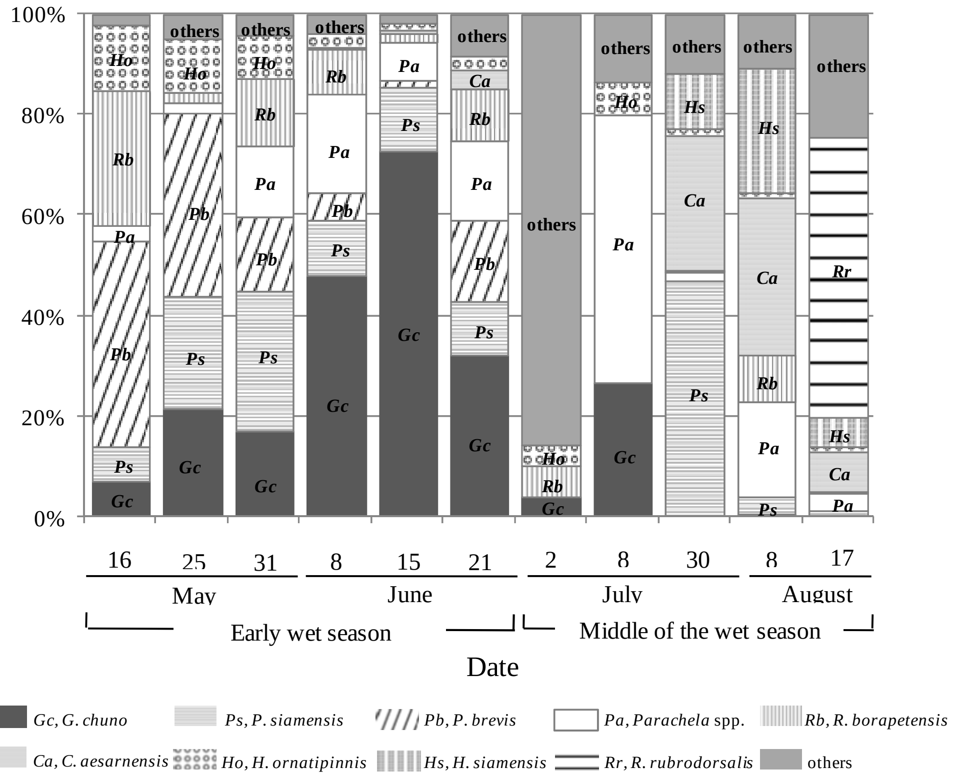

Figure 7. Seasonal changes in the relative abundances of dominant species collected in the floodplain from 16 May to 17 August 2006. *Gc, G. chuno*; *Ps, P. siamensis*; *Pb, P. brevis*; *Pa, Parachela* spp.; *Rb, R. borapetensis*; *Ca, C. aesarnensis*; *Ho, H. ornatipinnis*; *Hs, H. siamensis*; *Rr, R. rubrodorsalis*; others.

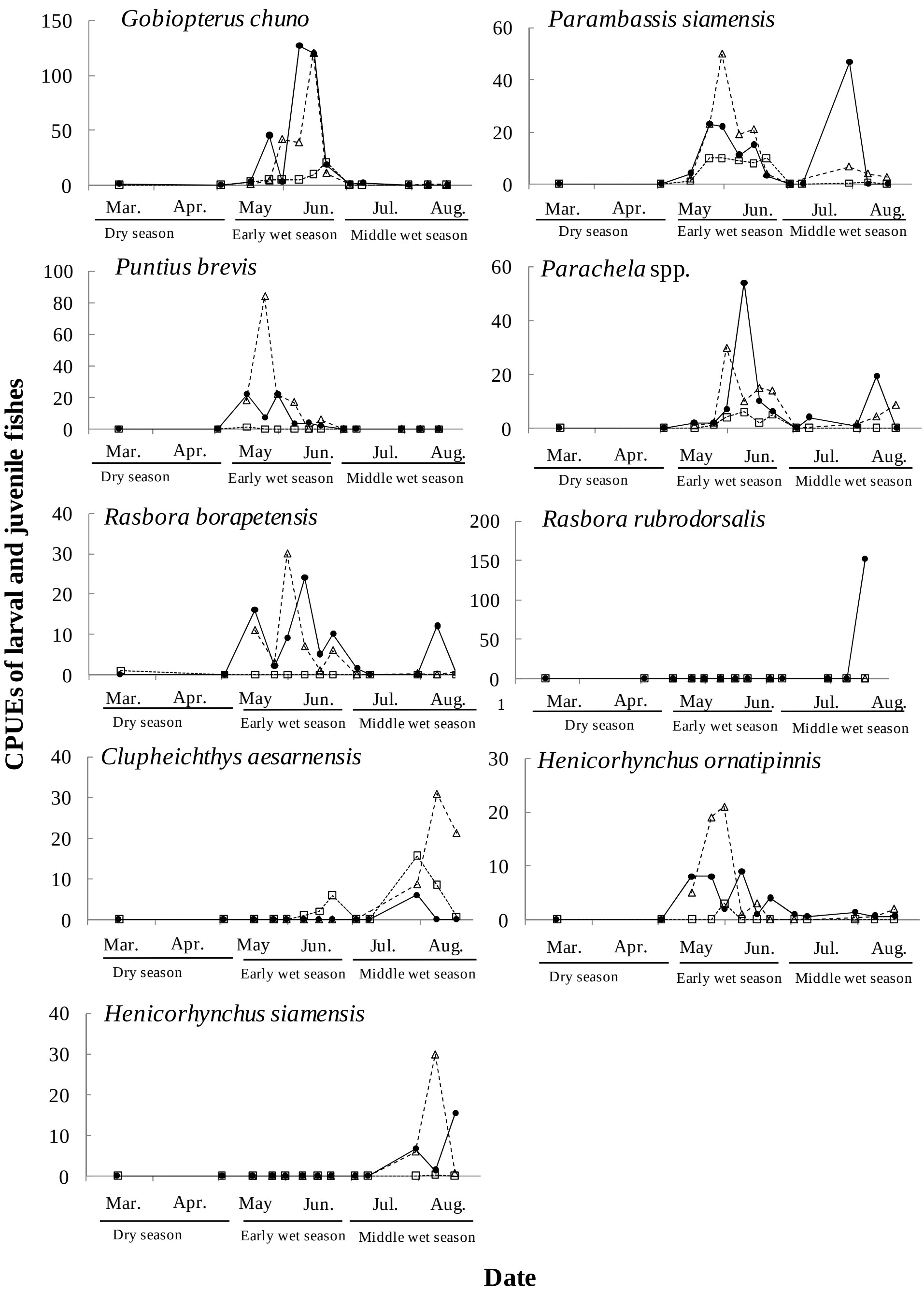

Figure 8. Seasonal changes in CPUEs of the top nine dominant larval and juvenile fishes in the center of a floodplain lake (□), the inundated area (△), and the shore line (●).

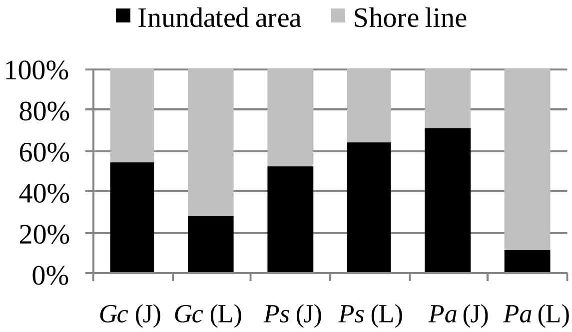

Figure 9. The relative abundances of larvae and juveniles of the three dominant species in the inundated area and the shoreline in the early wet season. *Gc, G. chuno*; *Ps, P. siamensis*; *Pa, Parachela* spp.; (J), juvenile; (L), larva.

DISCUSSION

We collected larvae and juveniles of at least 32 fish species; of these, 28 species occurred in the temporary waters of the floodplain, and the mean CPUE of the temporary waters was much greater than that of the permanent water. The temporary waters of the floodplain are considered important nursery grounds for larval and juvenile fishes because of their high food availability (Taki, 1978; Williams & Coad, 1979; Saito *et al*., 1988), and because the low oxygen levels may reduce predation by fish (Murkin *et al*., 1992).

In the early wet season, the littoral zone of the river was used by a limited number of species, with *Mystacoleucus* spp. and *Parambassis siamensis* accounting for 65.8% and 12.4% of the individuals, respectively. On 21 August 2006 (the middle of the wet season), eight species of young fishes which was close to juvenile's size were collected for the first time. We were unable to sample in September, but according to the experience of many local villagers (Kadan village and Kengkok village), young of various fishes move from the floodplains to the river when the water level declines. This movement is also mentioned by Smith (1945: 270–271). These results indicate that the littoral zone of the river is used by a limited number of species in the early wet season; however, after the water level drops it seemed to become an important nursery ground for young fishes whose juveniles grew in the floodplains, and river-floodplain connectivity is considered very important for some species.

The temporal waters of the floodplain appeared dramatically two times. First, during the early wet season the water levels of the floodplain lake increased because of rainfall, and the areas around the floodplain lake were inundated. Second, during the middle of the wet season the water level of the river rose sharply, and the river became connected to the floodplain lake, and large areas of the floodplain were inundated. Larval and juvenile fishes seem to occur in the floodplain according to the temporal waters appearance, because many larval and juvenile fishes were sampled around the early wet season and the middle of the wet season.

The dominant species changed dramatically among seasons. This change likely occurred because of differences in habitat use patterns and spawning triggers, as follows.

Three types of habitat use patterns for larval and juvenile fishes growing in the temporary waters of the floodplain lake are suggested by the present and previous study results. The nine dominant species and four additional species were classified into the three types of habitat use patterns. Type-A) The adults mainly inhabit stagnant floodplain waters, and the juveniles inhabit temporal waters: *Clupeichthys aesarnensis, Henicorhynchus ornatipinnis, Puntius brevis, Parachela* spp., *Rasbora borapetensis, Parambassis siamensis,* and *Gobiopterus chuno.* Type-B) The adults mainly live in the river, and the juveniles inhabit the temporal waters of the floodplain: *Henicorhynchus siamensis*, *Labiobarbus* sp., *Opsarius koratensis*, and *Paralaubuca* spp. Type-C) The adults and juveniles inhabit only the temporal waters: *Rasbora rubrodorsalis* and *Esomus metallicus.*

Clupeichthys aesarnensis, Henicorhynchus ornatipinnis, Puntius brevis, Parachela spp., *Rasbora borapetensis, Parambassis siamensis,* and *Gobiopterus chuno* are considered type-A fish because adults of these species were mainly sampled in the floodplain lake (including the temporary water) while the juveniles were sampled in the temporary water of the floodplain lake. The habitat use patterns of *C. aesarnensis, P. brevis,* and *P. siamensis* are also reported to be similar to the type-A species (IWATA *ET AL*., 2003). The habitat use patterns of *H. ornatipinnis, Parachela* spp., and *G. chuno* are recorded for the first time. IWATA *ET AL*. (2003) mentioned that *R. borapetensis* inhabits the permanent waters in all life stages, but *R. borapetensis* is considered a type-A species because most juveniles were sampled in the temporary waters.

Of the type-A species, *Henicorhynchus ornatipinnis, Puntius brevis,* and *Gobiopterus chuno* mainly occurred in the early wet season. The spawning triggers of these species seem to be related to rainfall in the early wet season. *Parachela* spp. and *Parambassis siamensis* seem to have long spawning periods, but the number of individuals in the middle wet season was lower than in the early wet season. In the middle wet season, the area of the inundated region was several times larger than in the early wet season, and the adults may diffuse through the floodplain. *Clupeichthys aesarnensis*, adults were collected during all study periods in the floodplain lake, but the occurrences of larvae and juveniles were concentrated in the middle wet season. Their spawning trigger seems to be related to rainfall in the middle wet season or the water level increases resulting from the river-floodplain connection. The spawning trigger of *Rasbora borapetensis* was not revealed in the present study because other triggers data like water temperature, pH, and the other water quality indices were not collected. These possible triggers need to be investigated in the future.

Of the type-B species, *Henicorhynchus siamensis*, which is a very important food resource for local people, migrates down the Mekong in the wet season (ROBERTS & BAIRD, 1995; WARREN *ET AL*., 2005), and migration of reproductively active *Cirrhinus lobatus* (as *Henicorhynchus lobatus* in KOTTELAT 2001) was observed during June–July (ROBERTS, 1997). Our study area was situated upstream of previous study sites; however, the first author also observed numerous *H. siamensis* with mature ovaries moving from the river to the floodplains when the water levels were rising, and heard loud vocalizations, probably of *H. siamensis*, on the floodplain lake at 2 July. ROBERTS & BAIRD (1995) noted vocalizations by *Cirrhinus lobatus*, which called to conspecifics during migration to the spawning grounds. Many *H. siamensis* juveniles occurred in the floodplain after July. Mature *H. siamensis* adults seemed to move to the floodplains for spawning, and the juveniles grew in the floodplains. The increases in river water levels are considered a spawning trigger for *H. siamensis*. The migrations of many type-B fishes are known from local ecological knowledge (BAO

ET AL., 2001), but the only type-B fish in the list of dominant species in our study was *H. siamensis*. This result is likely due to several reasons. First, the sampling sites were located several hundred meters from the river, and some type-B species might not have reached the sampling sites. Second, 14 species first occurred in the floodplains after the river-floodplain connection was established; it is possible that some of these were type-B species. Specifically, *Labiobarbus* sp., *Opsarius koratensis*, and *Paralaubuca* spp. were probably type-B species because their young were observed in the littoral zone of the river on 21 August, and these species migrate in the Mekong (Roberts & Baird, 1995; Baran *et al.*, 2005).

Of the type-C species, all life stages of *Rasbora rubrodorsalis* were only collected along the shoreline on 17 August 2006 (the middle of the wet season). On that day, the water level was the highest recorded in August and even areas of relatively high land were inundated. Therefore, *R. rubrodorsalis*, which only inhabits the temporary waters, was collected. *Esomus metallicus* was also only found in the temporary waters, regardless of life stage, and is probably a type-C fish. Iwata *et al.* (2003) also mentioned that these species only inhabited temporal waters.

Twelve species of post larvae were collected, and their abundances were relatively low compared to the values for juveniles. The lack of yolk-sac larvae samples is likely because of attrition from the seining, although it is also possible that yolk-sac larvae occurred at other sampling sites in the floodplains. Larvae of *Gobiopterus chuno* and *Parachela* spp. were collected mainly along the shoreline, but their juveniles occurred less frequently along the shoreline than in the inundated area. These species seem to change habitat according to developmental stages. Larvae were not fully sampled in the present study; therefore, future research should target larvae because larval distributions and habitat requirements may differ from juvenile and adult individuals.

In previous studies, the importance of connectivity between temporary floodplain waters and river-floodplains has been shown for some life stages of various fish species (Taki, 1978; Saito *et al.*, 1988; Iwata *et al.*, 2003; Baird, 2007). For the first time in the Mekong basin, our study shows seasonal occurrences of larval and juvenile fishes in the floodplain of a Mekong tributary. The results strongly support the importance of connectivity, and before river-floodplains connection inundated area by rainfall is also important for some fishes like type-A and C species. Furthermore, our study revealed that nursery grounds, such as the temporal waters of the floodplain and the littoral zone of the river, experience seasonal changes in species use, and that these changes are explained by three types of habitat use patterns and differences in spawning triggers. The seasonal occurrence of larval and juvenile fishes seems to be closely linked to the natural water regime.

ACKNOWLEDGEMENTS

We thank the Faculty of Forestry, National University of Laos, for granting us permission to undertake this research. We are also grateful to the Faculty of Agriculture, National University of Laos, for granting permission to transport our specimens to Japan for microscopic identification.

This study was partly funded by Grant-in-aid of Japan's Ministry of Education, Science and Culture (17201048); 'A study on the history of eco-environment along the transect from Hanoi to Yangon'.

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