Pilot study on the movement of Mekong giant catfish in the reservoir

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ABSTRACT

Mekong giant catfish *Pangasianodon gigas* is endangered species. It is urgently necessary to learn more about the movement pattern of the catfish to conserve. We started the Mekong giant Catfish Tracking Project (MCTP) that is ecological research cooperative with Thai government at 2001. In this paper, the first results of MCTP are introduced. Horizontal and vertical movements of Mekong giant catfish were determined using pressure-sensitive ultrasonic transmitters in the reservoir. We found the clear daily movement patterns of the catfish. The catfish appeared to favor relatively deep areas and had 2-3 km excursions at night. The catfish exhibited the ascent to the surface at dusk and the descent to the thermocline at dawn in the reservoir. These behaviors of the catfish might be related to the feeding behavior.

KEYWORDS: **Mekong giant catfish, endangered species, vertical and horizontal movement**

INTRODUCTION

The Mekong giant catfish *Pangasianodon gigas* is endemic to the Mekong River and growing to colossal size. The catfish shows one of the fastest growth rates of any fish in the world, reaching 150 to 200 kg in 6 years (Walter *et al.*, 1996). The catfish is also one of the largest freshwater fish in the world, measuring up to 3 m in length and weighing in excess of 300 kg. The catfish is known to feed on algae and planktons, occasionally swallows algae-covered stones inadvertently. The catfish may also eat insect larvae and periphyton attached to the stones (Walter *et al.*, 1996). The catfish used to be distributed throughout the Mekong River basin from Yunnan Province, China to Vietnam. Currently, the catfish seems to be limited to the Mekong River and its tributaries in Thailand, Laos and Cambodia (Fig. 1).

Although, in Cambodia, Cambodian law forbids the capture, sale, and transport of the endangered species including Mekong giant catfish, the fishermen capture the catfish by incidental catch every year in Tonle Sap Lake and its tributaries (Zeb et al., 2001). To prevent the catfish from becoming extinct, the catfish was tagged in the hope that the catfish would be recaptured these days. In Thailand, Thai law allows the capture of the Mekong giant catfish. It is generally said that the spawning grounds of the catfish are located near Chiang Khong District, the

northern part of Thailand. Now in Thailand, there is the only fishery cooperative of Chiang Khong District that is allowed to capture the wild catfish in the Mekong River. The fishermen in this cooperative use a gill net with a height of 3 m and mesh width of 40 cm to capture the catfish. The peak fishing season of the catfish starts from April to the end of May because the catfish migrates upstream to this district in this season to spawn. The river at this area is deeper and narrower, causing the current to flow swiftly. The fast current sweeps the catfish into the gill net and makes it difficult for the catfish to escape. In other districts, the catfish happens to be captured by incidental catch. The number of the wild catfish in the Mekong River has decreased due to the development of the Mekong River these days and so on. The behavior of the catfish, however, has been full of mystery.

As ecological researches are urgently necessary to conserve the catfish, the Mekong giant Catfish Tracking Project (MCTP) started in 2001, which is cooperative with Thai government. We have conducted the telemetry experiments at two study sites, the Mekong River and the Mea peum reservoir that are located in Phayao province, a northern part of Thailand (Fig. 1). The Mea peum reservoir is the enclosed waters. Enclosed waters can be the suitable site for the behavioral ecology of the catfish because continuous

tracking is possible. The objective of this paper is to introduce the first results of MCTP in the Mea peum reservoir.

MATERIALS AND METHODS
Study site
This experiment was conducted at the Mae Puem reservoir, which is located in Phayao province, a northern part of Thailand. This reservoir was constructed by damming up a river. The area of this reservoir is approximately 8.3 km2. The maximum depth is approximately 15 m. We surveyed the bottom topography all over the reservoir using an echo sounder.

Table 1. Summary of treament, body length, body weight, date tagged and date of track start.

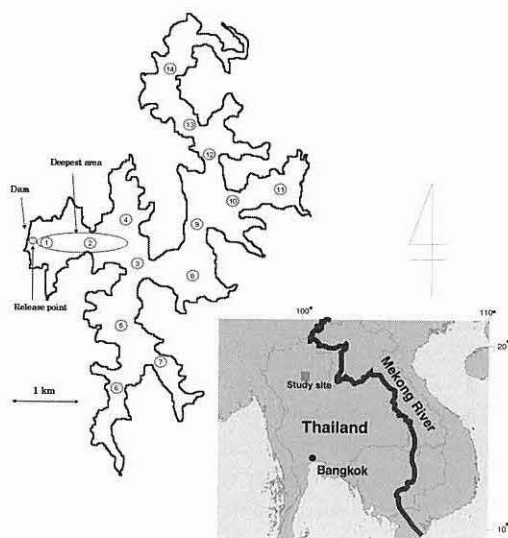| ID	Total length (cm)	Body weight (kg)	Date tagged	Date of track start
42	108	13	18-M ay–03	20-May-03
43	103	13.5	18-M ay–03	20-May-03
44	116	14.8	18-M ay–03	20-May-03
45	116	17.6	18-M ay–03	20-May-03
46	120	18.8	18-M ay–03	20-May-03
47	113	16.2	18-M ay–03	20-May-03
49	110	17.2	18-M ay–03	20-May-03
50	111	14.2	18-M ay–03	20-May-03

Fig. 1. Map of study site, Mea peum reservoir. This reservoir is located in Phayao province, a northern part of Thailand. This reservoir was constructed by damming up a river. The area of this reservoir is approximately 8.3 km2 and maximum depth is about 15 m.

Tagging and coded ultrasonic transmitters
Recently the Mekong giant catfish has been bred in captivity by Thai government and widely introduced through Thailand. Because it is difficult to capture the wild one, all cultivated fish (Table 1) were used in this study. All the catfish (n = 8) were about 1 m of total length, 6 to 11 years old and immature.

We used ultrasonic coded transmitters that were 16 mm in diameter, 108 mm long and weighed 16 g in water (V16P, Vemco Co., Ltd.). The frequency of the transmitter was 69 kHz. The power of the acoustic signals was 159 dB. The interval of the transmission was about 40 seconds. The transmitter transmits complex codes consisting of eight pulses in a transmission. So the receiver can identify and record the ID number of a transmitter and the depth of the sample fish swimming. This allowed us to identify up to potentially 256 different fish using the same frequency (Vogeli et al., 1998).

Transmitter Attachment
In May 2002 the experiment on the dummy transmitter was carried out to find the ideal attachment method, external or surgical internal attachment (Moore et al., 1990). We attached the dummy transmitter to the pectoral fin of the five fish for external attachment. We inserted the dummy transmitter to the peritoneal cavity of each 5 fish for the internal attachment. Each group of the catfish was reared for the external and internal attachment in the fish pond. Five intact fish were also reared for the contrast experiment under the same condition. About a month after the attachment, we concluded that the surgical implantation was better than the external attachment because all the external tags were removed and the change of the body weight of internal fish was not significantly different from the intact fish.

For the release experiment, the transmitter was implanted surgically into the peritoneal cavity of the catfish under the anesthesia following our previous method (Mitamura et al., 2002). After the surgery, the fish were kept in a pool for about one day to allow them to recover. The catfish showed no observable effect of the surgery on their behavior. The release experiment was carried out on May 20 2003. The catfish were released one at a time at the surface of the reservoir at the dam side (Fig. 1).

Tracking system
We used 14 VR2 systems (Vemco Ltd., Nova Scotia, Canada) for tracking tagged fish. The VR2 systems logged data on the presence of fish tagged with the coded transmitter. The dimension of the VR2 system is 60 mm in diameter with 205 mm length. The system has flush memories to record data and is powered by the lithium battery that lasts for up to 180 days. The receiver was installed at mid-water depth in a location in advance. The ID number, the date and time were recorded when the tagged fish passed within approximately 400 m of the receiver. We installed 14 VR2 systems in the Mea peum reservoir to cover all over the reservoir (Fig. 1). The areas around Sts. 1-4 and 9-12 were relatively deep, more than approximately 10 m. In contrast, other areas were shallow, up to 2 m deep. The data from VR2 systems were downloaded on 29-30 July 2003.

Water temperature

We measured the water temperature of the surface and the bottom of St. 1 in the reservoir during our experiment with two DT loggers (UME-190T, Little Leonard Co. Ltd.). This DT logger can record the ambient temperature and depth. Sampling intervals were 255 seconds. We also measured a vertical profile of the water temperature near St. 1 using another DT logger on 29 July 2003. In this measurement a sampling interval was 1 second.

RESULTS

Water temperature

Figure 2 shows water temperature of the surface and the bottom in the reservoir during our experiment. Average temperature of the surface and the bottom were 30.2 (±1.1 SD)°C and 23.6 (±0.6 deg. SD)°C respectively. Figure 3 shows the depth-temperature profile at the deepest area in the Mae peum reservoir nearby St. 1. Water temperature was stable from the surface layer to the depth of 6 m. However, it changed sharply at 6 m deep (Fig. 3).
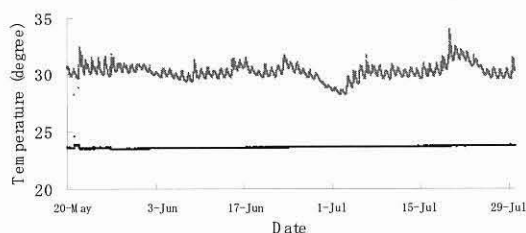

Fig. 2. Temperature of the surface and the bottom in the deepest area of the reservoir during approximately 70 days. Upper and lower lines indicated the temperature of the surface and the bottom, respectively.
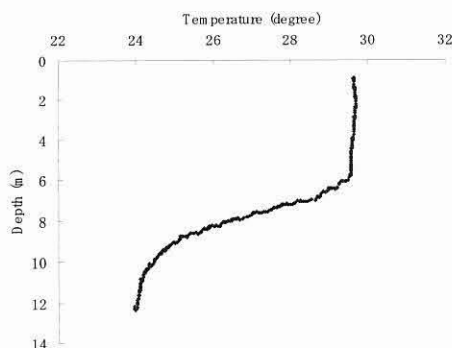

Fig. 3. Temperature profile in the deepest area of the reservoir.

Horizontal and vertical movement of Mekong giant catfish

All 14 receivers recorded the signals from the transmitters of tagged catfish when the data was downloaded approximately 70 days after the release.

The upper graph of Fig. 4 shows the horizontal movement of catfish 42 during our experiment. The catfish (ID 42) stayed mainly around Sts. 1-4 areas, which is the deepest in the reservoir. All tagged catfish appeared to favor relatively deep areas around Sts. 1-4 or Sts. 8-12 areas. The catfish (ID 42) generally favored deep areas, but the fish migrated all over the reservoir (Fig. 4). The lower graph of Fig. 4 shows horizontal movement of the catfish for a week after the release. The catfish migrated to other areas (Sts. 9-12) three times for a week although the catfish stayed mainly around Sts. 2-4. The fish conducted these 2-3 km excursions at night (Fig. 4). All catfish tended to have these short excursions at night although some excursions were made in the daytime.

Figure 5 shows the vertical movement of catfish 42 for a week after the release. There was clear vertical movement pattern during our experiment. The catfish swam upwards to the surface layer at dusk and remained below the surface at night. At dawn the catfish descended to depths around 6 m and remained there until the following dusk (Fig. 5). This catfish usually preferred deep areas where maximum depth is about 15 m (Fig. 4). However this catfish did not dive deeper than 6 m. The vertical profile of water temperature indicates that the mix layer was from surface layer to 6 m deep and that there was a sharp thermocline 6 m deep. This thermocline seems to be limited to the vertical movements of this catfish. This catfish appeared to spend the majority of all the time above the thermocline (Fig. 5). All other fish also exhibited the remarkable pattern of the vertical movement similar to ID 42. The clear day-night vertical movement may be common characteristic for Mekong giant catfish in the Mae peum reservoir.

DISCUSSION

Our results indicate that the catfish favored relatively deep areas and exhibited the vertical movements above the thermocline in the reservoir.

The Mekong giant catfish is known to feed on algae, occasionally swallows algae-covered stones inadvertently. The catfish may also eat insect larvae and periphyton attached to the stones (Walter *et al.*, 1996). In the Mae peum reservoir, some kinds of algae grow in the shallow areas and along the shore. Tagged catfish tended to migrate to other shallow areas from the main habitat or ascended to the surface at dusk. This movement to the shallow layer may be the movement to the shore from the deeper layer. In other words, the catfish may remain at the depth of 6-8 m above the thermocline in the daytime and move to the shore to feed on algae at night.

The Mekong giant catfish is also reported to feed on planktons (Walter *et al.*, 1996). Some of zoo plankton generally remains at the deep layer in the daytime and remains at the surface layer in the night time in both the sea and the lake (Hattorori, 1989, Gliwicz, 1986, Bollenz *et al.*, 1989). The Mekong giant catfish might vertically migrate to forage the zoo plankton in accordance with the movement of the zoo plankton. In order to learn more about the movement of the Mekong giant catfish it would be necessary to analyze stomach
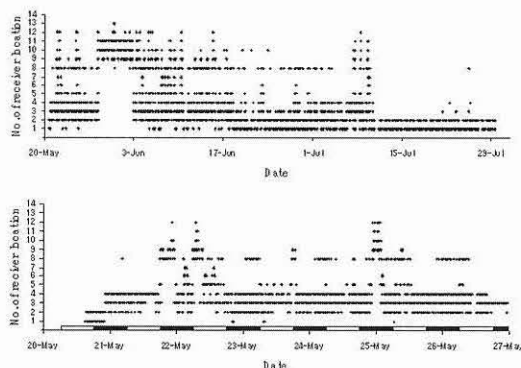
Fig. 4 Typical horizontal movement of the tagged catfish (ID 42). The dark horizontal bars indicate night time.
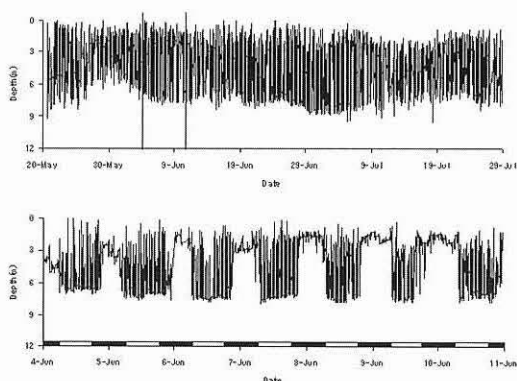

Fig. 5 Typical vertical movement of the tagged catfish (ID42). The dark horizontal bars indicate night time.

contents of the catfish. Additional experiments are needed to understand what and nowthe Mekong giant catfish feed on in the reservoir.

Horizontal and vertical movements of some fishes, for example Yellowfin tuna *Thunnus albacares* and bigeye tuna *Thunnus obesus*, were studied using ultrasonic transmitters and archival data loggers (Block *et al.,* 1997, Brill *et al.,* 1999, Dagorn *et al.,* 2000, Musyl *et al.,* 2003). These tunas exhibit clear vertical movement similar to the Mekong giant catfish. These tunas descend below the thermocline to forage and then return to the mixed layer in the daytime although they remain at the mixed layer at night. The thermocline limits the vertical movement of the tuna because tuna could not maintain body temperature for a long time below the thermocline. Therefore, these tunas spend major time above the thermocline. In the Mae peum reservoir, the change of temperature of thermocline is approximately 5-6 degree (Fig. 3). This change might limit the movement of the catfish.

In this study, we found that the catfish favored relatively deep areas and exhibited the vertical movements above the thermocline in the reservoir. These behaviors of tagged catfish might be associated with the feeding behavior.

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