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Study on the behavior of F2 Mekong giant catfish using ultrasonic telemetry

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ABSTRACT

The Department of Fisheries, Ministry of Agriculture & Cooperatives of the Thai government first succeeded in producing a second generation (F2) of Mekong giant catfish *Pangasianodon gigas* through artificial insemination in 2001. In order to compare the behavior of F2 catfish with those of the first generation (F1), we monitored ten F2 catfish for 18 days using ultrasonic telemetry in an artificial reservoir (Mae Peum reservoir, Phayao province, Thailand). The F2 catfish stayed shallower at night and deeper during the day, and avoided hypoxia areas of the reservoir. Since this diel vertical movement was observed in the previous study on F1 catfish, F2 catfish should be as behaviorally healthy as F1 catfish.

KEYWORDS: *Pangasianodon gigas*, acoustic telemetry, biotelemetry, second filial, stock enhancement

INTRODUCTION

In order to implement proper management and conservation of animals, it is essential to understand a given animal's behavior, its ambient physical environment, and their relationship (Sakamoto, 2005).

Mekong giant catfish *Pangasianodon gigas* is one of the largest freshwater fish in the world, reaching a maximum length of 3m and a total weight exceeding 300 kg. The catfish is endemic to the Mekong River Basin and culturally significant for local people because of its tastiness and size (Akagi et al., 1996). However, the population has decreased dramatically in the past century (Hogan 2004). The International Union for Conservation of Nature and Natural Resources (IUCN) listed the fish as critically endangered. The catfish is also listed on the Convention on International Trade in Endangered Species (CITES) Appendix I.

The Department of Fisheries, Ministry of Agriculture & Cooperatives of the Thai government (DFMACT) first succeeded in producing catfish juveniles (F1) through artificial insemination in 1983. Moreover, DFMACT has successfully produced a second generation (F2) of catfish through breeding F1 giant catfish in 2001. This artificial insemination technique has allowed the catfish seedlings to be produced without difficulty. In order to enhance the stock of the catfish in the Mekong River, DFMACT has stocked thousands of artificially reared giant catfish into the Mekong River. In addition to the stock enhancement in the Mekong River, attempts have been made to cultivate these hatchery-reared catfish in earthen ponds and many reservoirs.

In the previous study, Mitamura (2005) monitored the F1 Mekong giant catfish for more than a year using ultrasonic telemetry in the reservoir. He has concluded that the F1 catfish show diurnal rhythm, avoid sharp declines of temperature, and avoid hypoxia areas; such data are needed for management and conservation of the catfish.

Since available wild giant catfish are scarce, it is inevitable to use F2 giant catfish for the stock enhancement and cultivation of the catfish. However, little research has been conducted on the behavior of F2 giant catfish. F2 giant catfish could show a deterioration of survival viability and behavioral characteristics because it is produced by breeding of closely related F1 catfish, causing a loss of genetic diversity. Thus, revealing both survival viability and behavior of F2 are essential for the management of the fish.

In this study, we focused on the behavior of F2 giant catfish. We monitored the behavior of F2 catfish in relation to its ambient physical environment using ultrasonic biotelemetry. Then, we compared F2 behavior with that of F1 concluded by Mitamura (2005), in terms of diel rhythm and vertical movement in relation to physical environment. In this paper, we introduce the result of the study in the first 18 days of the monitoring (the monitoring is to be continued).

MATERIALS AND METHODS

We conducted the experiment in Mae Peum reservoir located in Phayao province of Thailand (Fig. 1).

Ultrasonic biotelemetry

We used ten hatchery-reared F2 giant catfish (TL: 63.5±2.4 cm, BW: 2.2±0.4 kg) in this experiment. All fish were considered to be immature. We surgically implanted ultrasonic coded transmitters (V9P-1H; 9 mm in diameter and 40 mm long, with a weight of 2.6 g in water; depth resolution ±20 cm; Vemco Ltd., Canada) into the peritoneal cavity of the fish under anesthesia. After the surgery, we kept the fish in a tank for 2 days to observe any negative effect of the operation. The ultrasonically tagged fish were released at the shore line on the dammed side of the Mae Peum reservoir (Fig. 1) on 1 September 2005. After the release, the signals from the fish were monitored using 7 ultrasonic receivers (VR2; 60 mm in diameter and 340 mm long; Vemco Ltd., Canada) (Fig. 1) that logged the ID number and depth of ultrasonically tagged fish within the detection range. We downloaded the receive data 18 days after the release.

Water temperature and dissolved oxygen

We measured the vertical profiles of dissolved oxygen and water temperature at 1 m intervals in depth at the receiver locations on 31 August and 7 September using a dissolved oxygen meter (Model 550A, YSI/Nanotech Inc., Japan).

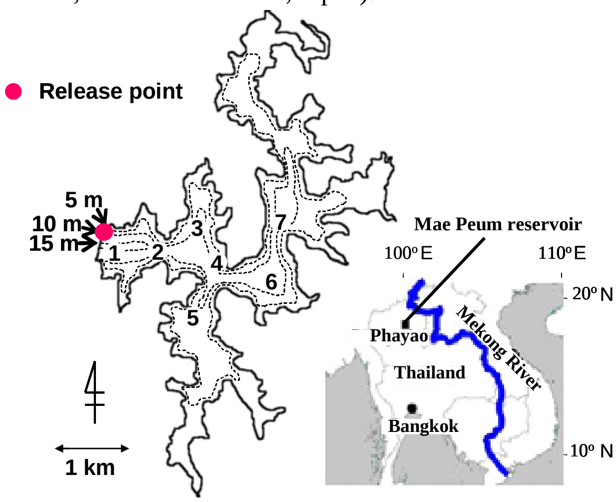

Fig. 1. The study site, Mae Peum reservoir. Release point (●) and receiver locations (**1-7**). Black circles represent the expected signal detection ranges. The reservoir map includes the contours of the bottom depth every 5 m.

RESULTS

One of the fish was found dead by local fisherman three days after the release. Another fish could have died or expelled the transmitter 14 days after the release because the data showed the fish had not moved vertically or horizontally at all since then. However, we succeeded in monitoring the other eight catfish continuously during the experiment (for 18 days after the release).

Horizontal and vertical movement

Figure 2 shows the typical horizontal movement of ultrasonically tagged F2 giant catfish. The tagged fish tended to stay around the release point for 4-7 days after the release, and then move to the area around St. 5 and St. 6. Figure 3 shows a part of the time-series depth data of one of the catfish. This indicates a typical diel vertical movement pattern. We also compared the mean depth distribution of the catfish between during the day and night (Fig. 4). The catfish were likely to stay deeper in the daytime and shallower in the nighttime. The giant catfish spent most of the time above the depth of 4 m (Fig. 4), even though the deeper area in the reservoir is more than 10 m in depth (Fig. 1).

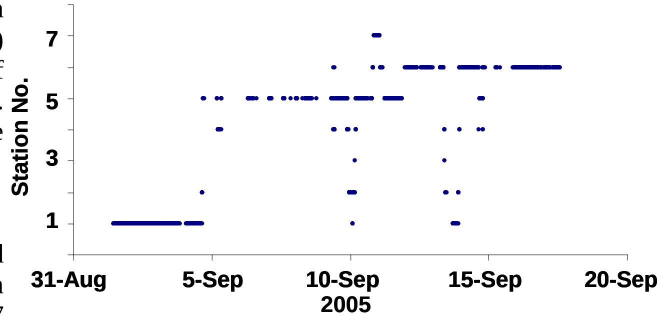

Fig. 2. Typical horizontal movement pattern of the F2 Mekong giant catfish.

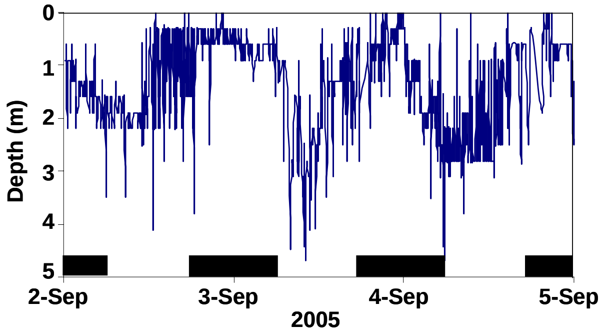

Fig. 3. Typical diel vertical movement pattern of the F2 Mekong giant catfish. The dark horizontal bars indicate the nighttime.

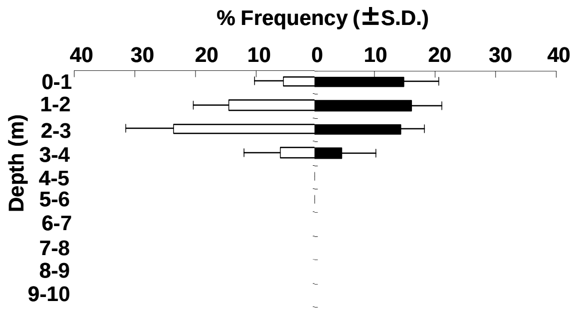

Fig. 4. Depth distribution (% frequency) of tagged Mekong giant catfish at each depth interval during the day and night. Horizontal bars indicate the standard deviation.

Vertical profiles of water temperature and dissolved oxygen

Vertical profiles of water temperature are provided in Figure 5. Water temperature decreased gradually in accordance with the depth; there was no sharp thermocline. Mean water temperature on 31 August and 7 September ranged from 29.8 °C (surface) to 24.1 °C (bottom) and 29.9 °C (surface) to 24.2 °C (bottom), respectively.

Figure 6 shows the vertical profiles of dissolved oxygen. Dissolved oxygen stratification occurred at a depth of 3-4 m. Dissolved oxygen levels below 4 m were extremely low: uniformly less than 10 %.

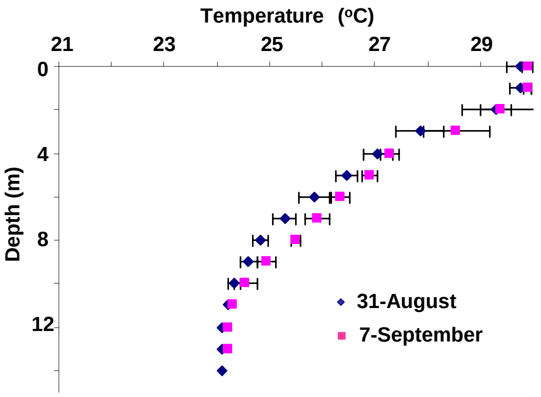

Fig. 5. The vertical profiles of mean water temperature on 31 August and 7 September in 2005. Horizontal bars represent the standard deviation.

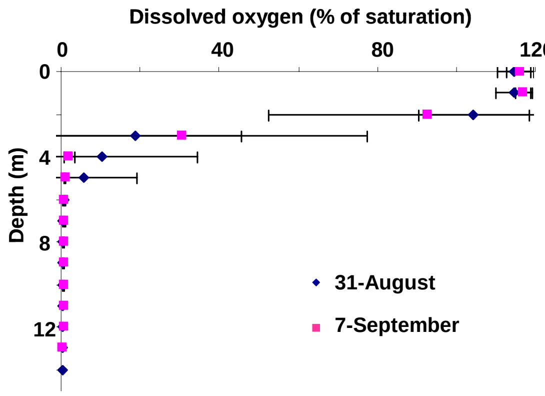

Fig. 6. The vertical profiles of mean dissolved oxygen on 31 August and 7 September in 2005. Horizontal bars represent the standard deviation.

DISCUSSION

Diel vertical movement

The catfish showed diel vertical movement; they stayed shallower at night and deeper during daylight hours (Fig. 3; Fig. 4). This diel movement is similar to that of F1 Mekong giant catfish reported by Mitamura (2005). He suggested that this behavior is related to feeding behavior; the catfish feed on algae at night more readily than during the day since algae are abundant at shallow water. If so, this diel movement could be an important behavior for survival in the reservoir. Thus, this behavior is a possible criterion to see if Mekong giant catfish seedlings are behaviorally healthy.

Vertical distribution in relation to dissolved oxygen

The catfish spent most of the time above 4 m in depth (Fig. 4) even though the deeper area of the reservoir is more than 10 m in depth (Fig. 1). Mitamura (2005) found that F1 Mekong giant catfish avoid sharp thermoclines and hypoxia areas. In this study, the water temperature gradually decreased in accordance with the depth and the differences between the surface and bottom were less than 6 °C (Fig. 5), which may not be critical for the fish to survive. However, there is very little dissolved oxygen (less than 10 % saturation) below 4 m in depth. Reductions in the level of available oxygen under 10 % of saturation have a fatal effect on fish (Mitamura 2005). Considering these facts, the F2 catfish probably avoided the hypoxia areas. Since avoiding hypoxia areas is essential for animals to survive in the natural environment, this behavior could also be evidence of the behavioral health of F2 giant catfish.

Final discussion and future study

F2 giant catfish showed the same behavioral characteristics as those of F1. This evidence supports the idea that the F2 giant catfish is as healthy as the F1 in terms of behavior. Nevertheless, since we monitored the tagged fish only for 18 days, we cannot conclude on the survival ability of the F2 giant catfish which is significant for the stock enhancement project. Our research team continued to monitor the ultrasonically tagged F2 giant catfish after this experiment. More data to reveal the behavioral characteristics and survival viability of the F2 Mekong giant catfish are anticipated.

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