THE ULTRASONIC TRACKING OF MEKONG GIANT CATFISH *PANGASIANODON GIGAS* IN MEKONG RIVER.

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SUMMARY

The Mekong giant catfish *Pangasianodon gigas* is endemic to the Mekong River, measuring up to 3 m in length and weighing in excess of 300 kg. The number of the wild catfish in the Mekong River has decreased due to the development of the Mekong River these days. Therefore, ecological researches are urgently needed to conserve the catfish. However, there was no method to monitor the movement of the catfish continuously in the Mekong River. The objective of this study was to test a feasibility of coded ultrasonic tracking system to monitor the contineous movement of the catfish in such a large river, the Mekong River. We released ten cultured catfish in the Mekong River. The catfish tended to move downstream or stayed around the release point just after the release. Four of ten catfish moved upstream for 60 km in 2-3 days although one fish moved downstream for 40 km. This tracking system that we tested could be a feasible system to monitor the continuous movement of the catfish in such a large river, the Mekong River.

INTRODUCTION [TP1]

The Mekong giant catfish *Pangasianodon gigas* is endemic to the Mekong River. The Mekong River is an international river which flows from China through Myanmar, Thailand, Laos, Cambodia, and Vietnam (Fig. 1). The catfish is 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 used to be distributed throughout the Mekong River basin from Yunnan P rovince, China to Vietnam. Currently, the catfish seems to be limited to The Mekong River and its tributaries in Thailand, Laos and Cambodia.

Although, in Cambodia, Cambodian law forbids the capture, sale, and transport of the endangered species including Mekong giant catfish, the fishermen capture the catfish incidentally every year in Tonle Sap Lake and its tributaries (Zeb et al., (2001)). To prevent the catfish from extinction, the catfish has been tagged

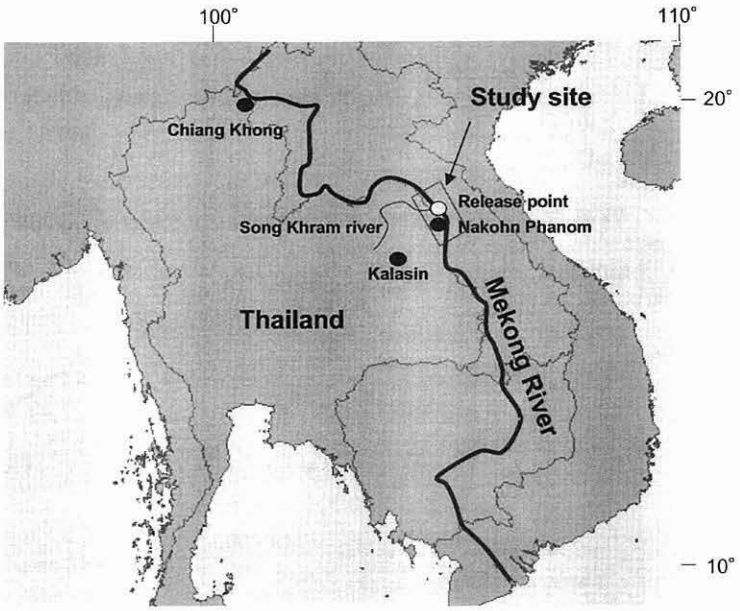

Fig. 1 Map of study site. Mekong River is a international river. The river flows through Myanmar, Thailand, Laos, Cambodia and Vietnam from China. We conducted this study to test feasibility of coded ultrasonic tracking system to monitor the continuous movement of the catfish in such a large river, the Mekong River

in the hope that the catfish would be recaptured.

In Thailand, Thai law allows the capture of the Mekong giant catfish. It is said that Chiang Khong District, the northern part of Thailand, was located near the spawning grounds of the catfish. In Thailand, there is only one fishery cooperative in Chiang Khong District, where they catch 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 catch the catfish. The peak fishing season of the catfish starts from April to the end of May because the catfish migrates upstream as far as to Chiang Khong 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 are captured incidentally. The number of the wild catfish in the Mekong River has decreased due to the recent development of the Mekong River. Therefore, ecological researches should take an urgent action to conserve the catfish. The objective of this study is to test feasibility of coded ultrasonic tracking system to monitor the continuous movement of Mekong giant catfish in such a large river, the Mekong River. We conducted this study cooperating with the Department of Fisheries (DOF), Thai government.

MATERIALS AND METHODS

STUDY SITE

In this study site, the water level of the Mekong River dramatically changes between the dry season and the rainy season. The width of the river changes from hundreds meter to some kilometers along with the change of water level. During our study, the width of the river in the study area was about 500 - 600 m. We started our tracking study only in Thailand. This study was conducted along the Mekong River in the Nakhon Phanom prefecture, the northeastern part of Thailand (Fig. 1).

EXPERIMENTAL FISH

Ten sample Mekong giant catfish *Pangasianodon gigas* cultured in the Karasin Freshwater Research Station in Karasin prefecture were used for the release experiment (Table 1). Five of ten sample catfish were about 1 m of fork length and the others were about 70 cm of fork length. Ten catfish were carried to the Nakhon Phanom Inland Fisheries Research Station from the Karasin Inland Fisheries Research Station before the attachment of ultrasonic coded transmitters (V16-4H, Vemco Co., Ltd.).

Table 1 The number of pulses from transmitters that were recorded in five VR1 systems. These pulses were ecorded from 18 August to 23 November 2002.

Station number of VR1 receiver	Number of pulses
St. 5	364
St. 1	344
St. 4	7089
St. 3	1688
St. 2	67

TRANSMITTERS

We used an ultrasonic coded transmitter that was 16 mm in diameter, 65 mm long and weighed 10 g in water. The frequency of the transmitter was 69 kHz. The power of the acoustic signals is 153 dB. The interval of the transmission was about 20 seconds. The battery lasted for 406 days. The transmitter transmits complex codes consisting of six pulses in a transmission. If the receiver perfectly receives all the six pulses of a transmitter, the receiver can identify and record the ID number of a transmitter. If the receiver can not identify the ID number, it records only the number of pulses. Two hundreds fifty six different fish were identified on the same frequency using this transmitter (Vogeli et al. (1998)).

EXPERIMENTAL DEPLOYMENT

In May 2002 the experiment on the dummy transmitter attachment was carried out to find the ideal attachment method, external or surgical internal attachment. We attached the dummy transmitter to the pectoral fin for external attachment. We inserted the dummy transmitter to the abdomen of the fish for internal attachment. Each 5 fish were reared for 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 dummy transmitter attachment, we concluded that the surgical implantation was better than the external attachment because all the dummy transmitters of external attachment were removed and the change of the body weight of internal fish and intact fish were not significantly different after the experiment.

ACTUAL DEPLOYMENT AND RELEASE

The transmitter was implanted surgically into the abdominal cavity of the catfish under the anesthesia following our previous method (Mitamura et al. (2002)). After the surgical treatment, the fish were kept in a pool for about one day to be under the observation of the body condition of the experimental fish after the tag deployment.

The release experiment was carried out on 27th of June, 2002. The catfish were released one by one at the surface of the river. The release point was the mouth of the Song Khram River which is one of the branches of the Mekong River (Fig. 1).

TRACKING SYSTEM [TP2]

We used two different types of receiving systems, including five VR1 and one VR60 systems (Vemco Co., Ltd., Nova Scotia, Canada) for tracking the tagged fish. The VR1 system is able to record the attendance of the fish tagged with the coded transmitters. The dimension is 60 mm in diameter and 205 mm in length. The system is powered by the lithium battery lasted for 180 days and had flush-memories inside to record data. This receiver is installed in the place at a middle water depth where the tagged fish pass through in advance. The ID number, the date and time are recorded when the tagged fish pass in the expected detection range of the receiver. The detection range experiment of coded ultrasonic transmitters was carried out in December 2001 in Mukdahan, Thailand because we have not conducted biotelemetry in such a large river. As a result, the expected detection range using the transmitters (V16, Vemco Co. Ltd.) and receiver systems (VR1, Vemco Co. Ltd.) were about 200-300 m. This receiving system can not perfectly cover up to opposite side because the width of the river is about 500 - 600 m. when the experimental fish pass through along the Thai side, the receiver can detect the attendance of the fish.

We also tracked the tagged fish using the VR60 system on board for two days just after the release. The VR60 system had one hydrophone to detect the direction of the fish with a transmitter. The hydrophone was installed in a research vessel. Signals from the coded transmitters were received by the hydrophone system. We could acquire the ID number of the coded transmitter and the position of the vessel using the Garmin GPS receiver (Garmin, Olathe, KS, USA). The Garmin GPS receivers are accurate to within 15 m on average.

TRACKING PERIODS AND PLACEMENT OF FIXED STATIONS

We installed five VR1 systems in the Mekong River. Two of five VR1 systems were set up near the release point. One receiver was set up at the branch. Another receiver was set up at the place about 60 km upstream of the release point, Bannakhae district in Nakhon Phanom prefecture. The other was set up at the place about 40 km downstream of the release point in front of the River View Hotel in Nakhon Phanom city. The data from five VR1 systems were downloaded on 18th of August 2002. After downloading for the first time, we changed the set up location of two VR1 systems for covering more upstream areas (Fig. 2). One at the branch was replaced to the place about 100 km upstream of the release point. One near the release point was replaced to the place between the release point and Bannakhe district. Secondly we downloaded the data of the five VR1 systems on 23rd of November 2002.

RESULTS AND DISCUSSION

All the five VR1 systems recorded the attendance of the tagged catfish after the release. Figure 3 summarizes the results of the catfish's behavior for ten days after the release. Just after the release, two VR1 systems installed around the release point recorded the attendance of all catfish. ID 1 and 5 catfish were recorded for 5 days at the release point. These catfish stayed near the release point for 5 days. ID 3, 7 and 8 catfish were recorded again near the release point 4-7 days after the release. This result means that these fish stayed in the area between the receiving stations or they moved past the receiving station swimming away from the detection range of the receiving system. ID 6 catfish was recorded at the branch for three days after the release and then recorded near the release point. This result means that the catfish moved to the branch after the release and moved back to the main stream of the Mekong River. Four catfish (ID 1, 3, 6 and 8) were recorded for about an hour respectively 6

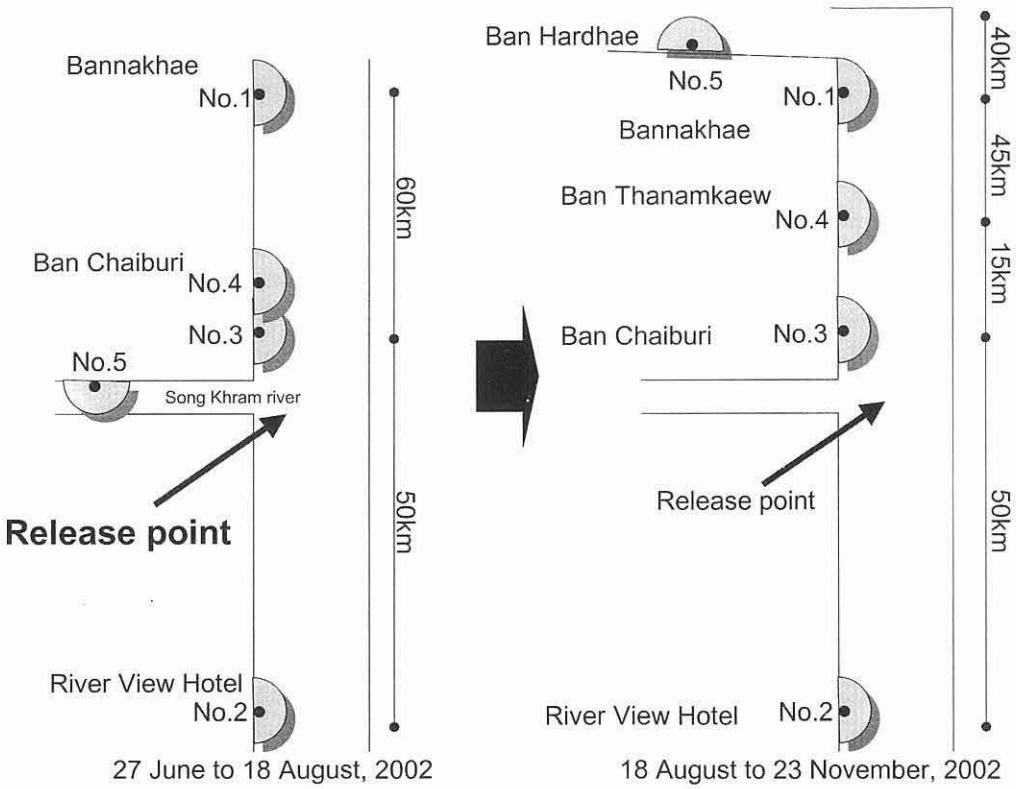

Fig. 2 We changed the set up location of two VR1 receiver systems for covering more upstream areas. Two receivers were moved from the locations of the left figure to the locations of the right figure in Fig. 2.

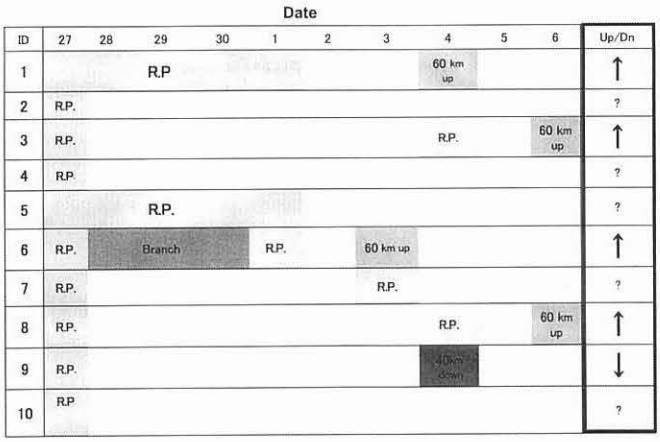

Fig. 3 The summary of the catfish's behavior for ten days after the release. R.P. shows that the catfish recorded by the VR1 receiver that was set up at the release point. Branch shows that the catfish recorded by the VR1 receiver that was set up at the branch. 60 km up and 40 km down show that the catfish recorded by the VR1 receivers that were set up at the 60 km upstream point and the 40 km downstream point from the release point.

to 9 days after the release by the VR1 system that was installed at the place about 60 km upstream of the release point. These catfish swam very actively toward upstream for 60 km within two or three days. One catfish (ID 9) was recorded for about an hour 7 days after the release by the VR1 system at the place about 40 km downstream of the release point. The VR1 receiver installed at St. 2 recorded the attendance of this catfish for about an hour. If the catfish was dead and drifted downstream by the river stream, signals from the catfish would not be recorded for about an hour because the current speed of the Mekong River was relatively faster. After 7 July 2002, all the receivers did not record ID numbers of the tagged catfish.

Using VR60 system on board, we could track all the tagged catfish moved downstream 500 m to 1 km from the release point gradually just after the release. ID 6 catfish could also be tracked at the branch, Song Khram River, a day after the release. They experienced the natural river that was so deep and large for the first time in this release experiment. They would drift downstream slowly with the current of the river after the release.

When we downloaded the data from five VR1 systems on 23rd of November 2002 for the second time, the ID numbers of transmitters within the catfish could not be recorded at all. However, the five VR1 systems recorded many pulses of the transmitters as follows, 364 pulses at St. 5, 344 pulses at St. 1, 7089 pulses at St. 4, 1688 pulses at St. 3 and 67 pulses at St. 2 (Table 2). The VR1 receiver at St. 3 and St. 4 recorded more pulses than the other receivers. Therefore, some Mekong giant catfish might stay or pass upstream around St. 3 and St. 4 although we could not identify the ID number of the tagged catfish. The receiver at St. 2 recorded less pulses than the other receivers. Therefore the catfish might not move downstream or stayed around St. 2 except for ID 9 catfish.

In this study, we could track the Mekong giant catfish in the Mekong River using these tracking systems. Therefore, this tracking system could be a feasible system to monitor the continuous movement of Mekong giant catfish in such a large river, the Mekong River. We also found that the catfish have an active swimming ability because four of ten catfish moved upstream for 60 km within two or three days. However, the important questions, "why do they migrate upstream?" and "does the wild Mekong giant catfish also migrate upstream?" remain to be answered.

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REFERENCE

Mitamura H, Arai N, Sakamoto W, Mitsunaga Y, Maruo T, Mukai Y, Nakamura K, Sasaki M, Yoneda Y, 2002. Evidence of homing of black rockfish Sebastes inermis using biotelemetry. *Fish. Sci.*, **68**, 1189-1196.

Voegeli FA, Lacroix GL, Anderson JM., 1998. Development of miniature pingers for tracking Atlantic salmon smolts at sea. *Hydrobiologia*, **371/372**, 35-46.

Zeb Hogan, Ngor Pangbun, Niek van Zalinge, 2001. Endangered Mekong giant catfish *Pangasianodon gigas* and giant barb Catlocarpio siamensis in the Tonle Sap river, Cambodia.