Title	A review of the Mekong giant catfish tracking project (MCTP) from 2002 to 2004
Author(s)	MITAMURA, HIROMICHI; MITSUNAGA, YASUSHI; ARAI, NOBUAKI; YAMAGISHI, YUKIKO; KHACHAPHICHAT, METHA; VIPUTHANUMAS, THAVEE
Citation	Proceedings of the 2nd International symposium on SEASTAR2000 and Asian Bio-logging Science (The 6th SEASTAR2000 Workshop) (2005): 7-11
Issue Date	2005
URL	http://hdl.handle.net/2433/44075
Right	
Type	Conference Paper
Textversion	publisher

A review of the Mekong giant catfish tracking project (MCTP) from 2002 to 2004

HROMICHI MITAMURA[1], YASUSHI MITSUNAGA[2], NOBUAKI ARAI, YUKIKO YAMAGISHI[1], KHACHA METHA[3], THAVEE VIPUTHANUMAS[4]

[1]*Graduate School of Informatics, Kyoto University, Kyoto 606-8501, Japan*

Email: mitamura@bre.soc.i.kyoto-u.ac.jp

[2]*Faculty of Agriculture, Kinki University, Nara 631-8505, Japan*

[3] *Phayao Inland Fisheries Station, Phayao Province, 19000, Thailand*

[4]*Inland Fisheries Research and Development Bureau, Kasetsart University, Bangkok, 10900, Thailand*

ABSTRACT

For the conservation and successful stock enhancement of the endangered species Mekong giant catfish *Pangasianodon gigas*, an understanding of its movement patterns and behavior is indispensable. The Mekong giant catfish tracking project (MCTP) has been begun to measure the movements of hatchery-reared Mekong giant catfish using acoustic telemetry and bio-logging technology in the Mae peum reservoir and Mekong River. Research in the Mae peum reservoir demonstrated that fish showed distinctive diel vertical movement and the swimming depth was limited by the thermocline or dissolved oxygen stratification. Fish also displayed diel horizontal movement between inshore at night and offshore areas during the day. Researchers in the Mekong River presented the first records of upstream and downstream movement of Mekong giant catfish for up to 97 days. Fish swam upstream at a speed of 16.2 km d^{-1} and downstream at a speed of 7.2 km d^{-1} during a day. These results will contribute to plans for the species conservation and the effective stock enhancement in reservoirs and fish ponds.

KEYWORDS: MCTP, Mekong giant catfish, *Pangasianodon gigas*, Horizontal and vertical movement, Mae peum reservoir, Mekong River

MEKONG GIANT CATFISH IN SOUTHEAST ASIA

The Mekong giant catfish (Fig. 1) is endemic to the Mekong River Basin and grows to a very large size. This catfish is one of the largest freshwater fishes in the world, measuring up to 3 m in length and weighing in excess of 300 kg (Rainboth 1996). This species has one of the fastest growth rates of any fish in the world and can reach 150-200 kg in 6 years (Rainboth 1996). In Southeast Asia, this catfish has historically been popular with the local people, and there are folklores and hallowed traditions associated with it. For example, the catfish is viewed by some to be a messenger of God, and local people perform annual pre-catch folk rituals (Akagi et al. 1996). Furthermore, the catfish is one of the most important fisheries species of the Mekong River Basin and is traded at a high price in Southeast Asia (Fig. 2).

Fig. 1. A hatchery-reared Mekong giant catfish.

In Thailand, only the fishery cooperative of the Chaing Kong District in Chaing Rai Province is allowed to capture wild catfish in the Mekong River (Fig. 3). The fishermen in this cooperative use gill nets that are 3 m tall and have a mesh width of 40 cm to capture the catfish (representative of the fishery cooperative, personal communication; Fig. 3). The peak catfish fishing season occurs from April to the end of May, because the fish migrate upstream to this district at this time to spawn (Akagi et al. 1996, Mattson et al. 2002). The catch number of wild catfish in the Mekong River has declined due to development of the river and over-fishing (Hogan 2004). From 1986-2003, a maximum annual catch of 62 fish was reported in this district in 1990, whereas no catfish were caught from 2001-2003 (Fig. 3). This decline in catch number implies that the wild catfish may be close to extinction. Hogan et al. (2004) estimated that the total number of wild catfish in the Mekong River has decreased by approximately 90% during the past two decades. At present, the catfish is listed in CITES Appendix I and on the IUCN Red List of threatened species as a Critically Endangered Species.

Several approaches have been attempted to manage and conserve the Mekong giant catfish in Southeast Asia. In Cambodia, although fishermen capture the catfish as incidental catches in the local bagnet fishery in Tonle Sap Lake and its tributaries, the catfish are bought, tagged with labeled plastic tags, and released back into the natural environment with the hope that the fish will be recaptured (Hogan 2004, Hogan et al., 2004). This conservation program began in 2000, and large catfish captured alive in the lowest stretches of the Tonle Sap basin have been released each year (Hogan 2004). In Thailand, artificial insemination techniques for catfish were developed in 1983, and it is relatively easy to produce catfish fry using captive mature male and female catfish (Fig. 4). Furthermore, a second (F2) generation of catfish can be successfully produced. Recently, sex hormone profiles, gonad development, and age determination of catfish have been clarified (Manosroi et al., 2003). Thus, the Thai government has released and cultivated catfish in earthen ponds and in many reservoirs for the enhancement of the stock (Fig. 5).

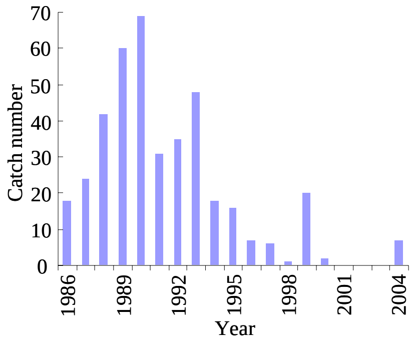
a)

b)

Fig. 2. Incidental catch of a Mekong giant catfish in Nakhon Phanom on 16 December 2001 (a); the fish was sold to the local people (b).

MEKONG GIANT CATFISH TRACKING PROJECT (MCTP)

For the success of stock-enhancement programs and its species conservation, ecological knowledge of the natural habitat of the target species is required (Masuda and Tsukamoto, 1998). Moreover, reservoirs, lakes, and ponds identified for the release of catfish should be large enough to encompass the daily and seasonal movement patterns of adult and juvenile fish (DeMartini 1993, Nowlis and Roberts 1999, Lowe et al. 2003). Previous studies on catfish, however, have provided little information on their movements; thus, the behavior of these fish under natural conditions remains largely unknown. Therefore, ecological data are required for the effective management of this species. One of the most effective ways to quantify the movement patterns of fish species is through the use of acoustic telemetry (Holland et al. 1996, Meyer et al. 2000, Mitamura et al. 2002). Therefore, we have begun a Mekong giant catfish tracking project (MCTP) in cooperation with the Thai government (Arai et al. 2005). One of the objectives of this project was to quantify the movement patterns of hatchery-reared Mekong giant catfish in a reservoir and the Mekong River using advanced biotelemetry systems since 2001. This paper describes the review of the results of movement patterns of the Mekong giant catfish determined in the MCTP from 2002 to 2004.



a)

b)

Fig. 3. Annual catch number of Mekong giant catfish in the Chaing Khong District, Chaing Rai Province, Thailand (a). A representative of the Chaing Khong fishery cooperative in December 2002 (b). He was 75 years old at the time and had been a fisherman since the age of 12. More than 100 wild giant catfish were caught during his lifetime, and the maximum and minimum body weights of the fish were approximately 280 and 120 kg.

EFFECT OF ATTACHING TELEMETRY TRANSMITTERS TO MEKONG GIANT CATFISH

We examined the effects of external attachment and surgical implantation on the survival and growth of the catfish compared with those of the control individuals in an earthen fish pond at Karasin Inland Fisheries Station, Department of Fisheries, Thailand for approximately 2 months (Mitamura 2005, Mitamura et al. in press). During the experimental period, no fish died. Furthermore, we found no fungal infections in any fish and no significant differences among treatment and control fish in growth rates. However, all transmitters of externally tagged fish were lost during the experimental period. In contrast, transmitters of some surgically implanted fish remained in the peritoneal cavity during the experimental period. In conclusion the surgical implantation technique was suitable for the long-term monitoring of the catfish.

a)

b)

Fig. 4. Monument to the reproduction of Mekong giant catfish in Chaing Khong District, Chaing Rai Province, Thailand (a), and first-generation catfish fry (F1) (b).

ANNUAL AND DIEL MOVEMENT PATTERNS AS MEASURED USING ACOUSTIC TELEMETRY IN MAE PEUM RESERVOIR, THAILAND

The horizontal and vertical movements of 8 immature hatchery-reared Mekong giant catfish were monitored in Mae Peum reservoir (Fig. 6), Thailand for up to approximately 15 months from May 2003 to August 2004 using acoustic telemetry (Mitamura 2005). The horizontal utilization distribution of fish during the rainy and dry seasons ranged from 0.0040 to 1.1 km^2 and from 0.01 to 0.25 km^2, respectively. There was no difference among fish nor between the rainy and dry seasons in the horizontal utilization distribution. The catfish displayed distinctive diel horizontal movement between the inshore during the day and offshore areas of the reservoir at night. The catfish showed active vertical movement during the day and did not change their swimming depth at night all year round (Fig. 7). These vertical movements were limited by the thermocline and the vertical distribution of fish changed along with that of water temperature during a year. These movement data indicated that the hatchery-reared catfish can adapt to the natural environment. Our results provide useful information for reinforcement of hatchery-reared catfish into the Mekong River.

Fig. 5. Release of F2 Mekong giant catfish (Appro. 10 cm) into Lake Kwan Phayao, Phayao Province, Thailand on 18 December 2005.

VERTICAL MOVEMENTS OF ONE MEKONG GIANT CATFISH MONITORED BY MULTI-SENSOR MICRO DATA LOGGER IN MAE PEUM RESERVOIR, THAILAND

The vertical movements of one immature hatchery-reared Mekong giant catfish were monitored for 3 days in August 2004 using a depth-temperature micro data logger (Mitamura 2005). The logger was recovered using an innovative time-scheduled release system and located by searching for VHF radio signals. The logger was found approximately 2.2 km away from the release point and provided (n = 705128) depth and temperature data collected over a period of 98 hours following the release. The fish spent more than 99 % of its time at less than 3 m below the surface. The maximum swimming depth was 5.6 m. No sharp thermocline was present during the experiment, with the temperature ranging from 28 to 30°C along the water column. Temperature did not have any detectable effect on the fish pattern of vertical movement. The dissolved oxygen concentration (DO) was stratified with a concentration >60% of saturation in the first 3 m below the surface, falling to 10% saturation deeper than 4 m. The DO stratification limited the vertical movement of the catfish (Fig. 8).

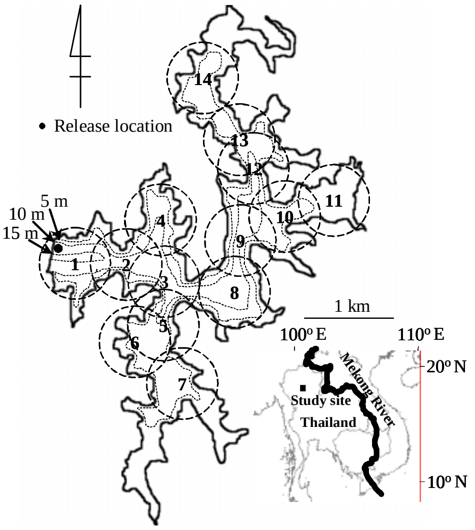


Fig. 6. Map of the Mae Peum reservoir in the province of Phayao, Thailand. Dashed circles represent the expected signal detection range of the coded ultrasonic transmitters. The small filled circle represents the location of fish release.

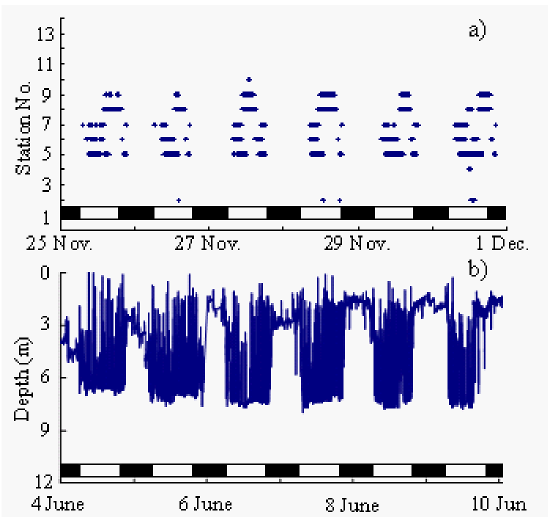


Fig. 7. Typical horizontal (a) and vertical (b) movement of catfish during the rainy season. White and black bars indicate day and night, respectively.

REINFORCEMENT OF HATCHERY-REARED CATFISH INTO THE MEKONG RIVER FOR CONSERVATION

The horizontal and vertical movements of 28 immature hatchery-reared Mekong giant catfish were monitored in Mekong River, Thailand from 2002 to 2004 using acoustic telemetry (Mitamura 2005). This study presents the first records of upstream and downstream movement of Mekong giant catfish for up to 97 days. Fish remained close to the release point for several days after release and subsequently swam upstream at a speed of 16.2 km d^{-1} and downstream at a speed of 7.2 km d^{-1} during a day. Fish also displayed vertical movement between the surface and bottom (range: 1.0-12.1 m) during the day. These results showed that hatchery-reared fish were able to survive in the Mekong River over a long time span. Furthermore, these fish were able to swim against the fastest river flow. This may indicate that the introduced fish have the ability to migrate between spawning and habitat sites. Additional laboratory evidence suggests that these fish have the ability to spawn when mature. This suggests that reinforcements should greatly enhance the stock potential of this catfish.

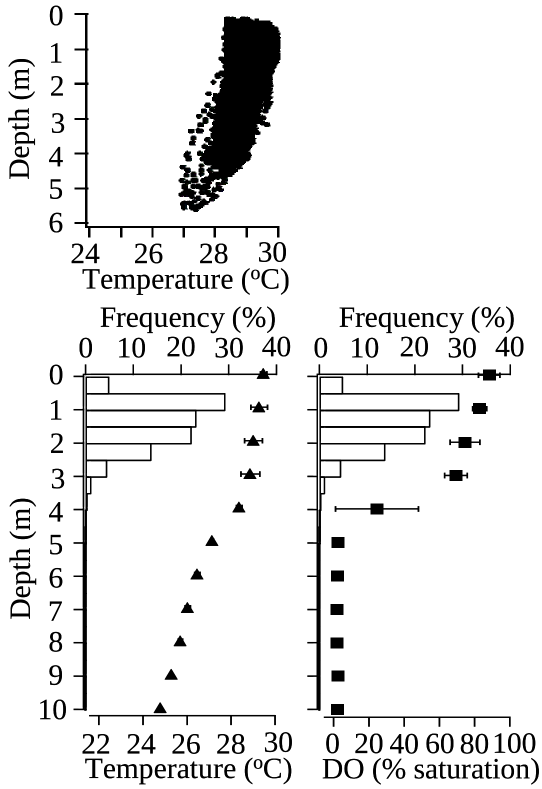


Fig. 8. Swimming depth with water temperature (upper panel) and frequency of swimming depths with the vertical distribution of water temperature and dissolved oxygen (lower panels). Triangles indicate temperatures, squares indicate dissolved oxygen (DO) concentrations, and horizontal bars indicate the S.D.

SUMMARY OF THE MOVEMENT PATTERNS OF MEKONG GIANT CATFISH

Fish showed distinctive vertical movement during the day. The swimming depth was limited by the thermocline or dissolved oxygen stratification. During the periods when there was no thermocline or dissolved oxygen stratification, fish dove to the bottom (approximately 12 m deep). At night, fish may have remained in the relatively shallow depth. Fish also displayed diel horizontal movement between inshore at night and offshore areas during the day. Although data from the Mekong

River experiment were not abundant, we believe that this diel vertical and horizontal movement occurs both in the reservoir and the Mekong River. For seasonal movement, the vertical distribution of fish was deeper during the dry than during the rainy season. This would be caused by mixing of the waters from the bottom and surface during the dry season. There was no seasonal variation in habitat size, although fish repeatedly moved among areas at 1-2-month intervals.

These results will contribute to plans for effective stock enhancement in reservoirs and fish ponds. Furthermore, based on the results presented in these studies, restocking of the species with hatchery-reared catfish may result in a successful reinforcement program. The next areas of research are to measure the behavior of the hatchery-reared catfish, such as swimming ability and activity patterns, and the movement patterns of F2 catfish.

ACKNOWLEDGEMENTS

We deeply thank all staffs of all Inland Fisheries Station, Thailand, for their kind support, advice and contributions in conducting the research in Thailand. This study was partly supported by a Grant-in-Aid for Scientific Research (13375005, 12556032, 14560149 and 15・5686) and Information Research Center for Development of Knowledge Society Infrastructure, the Ministry of Education, Culture, Sports, Science and Technology.

REFERENCES

Akagi O. Akimichi T. Fumihito A. Takai Y. (1996). An ethonoichthyological study of *Pla buk* (*Pangasianodon gigas*) at Chiangkhong, Northern Thailand. *Bull. Nat. Muse. Ethno*. **21,** 293-344.

Arai N. Mitamura H. Mitsunaga Y. Viputhanumas T. (2005). Mekong giant catfish tracking project (MCTP): preliminary results in 2002. In: Spedicato M.T. Lembo G. Marmulla G. (Eds) Aquatic telemetry; advances and applications. Rome FAO/Coispa. 125-131.

DeMartini E. (1993). Modeling the potential of fishery reserves for managing Pacific coral reef fishes. *Fish. Bull.* **91,** 414-427.

Hogan Z.S. (2004).Threatened fishes of the world: *Pangasianodon gigas* Chevey, 1931 (Pangasiidae). *Env. Biol. Fish.* **92**, 210.

Hogan Z.S. Moyle P.B. May B. Vander Zanden M.J. Baird I.G. (2004). The Imperiled Giants of the Mekong. *Amer. Sci*. **92**, 228-237.

Holland K.N. Lowe C.G. Wetherbee B.M. (1996). Movements and dispersal patterns of blue trevally (*Caranx melampygus*) in a fisheries conservation zone. *Fish. Res.* **25**, 279-292.

Lowe C.G. Topping D.T. Cartamil D.P. Papastamatiou Y.P. (2003). Movement patterns, home range, and habitat utilization of adult kelp bass *Paralabrax clathratus* in a temperate no-take marine reserve. *Mar. Ecol. Prog. Ser.* **256**, 205-216.

Manosroi A. Men-Umphan K. Manosroi J. (2003). Annual sex hormonal profiles, gonad development and age determination of the Mekong giant catfish (*Pangasianodon gigas*, Chevey). *Aquacul. Res.* **34**, 1379-1385.

Masuda R. Tsukamoto K. (1998). Stock enhancement in Japan: Reviewed and perspective. *Bull. Mar. Sci.* **62,**337-358.

Mattson N.S. Buakhamvongsa K. Sukumasavin N. Tuan N. Vibol O. (2002). Cambodia Mekong giant fish species: on their management and biology. MRC Technical Paper No. 3. Mekong River Commission. 1-29.

Meyer C.G. Holland K.N. Wetherbee B.M. Lowe C.G. (2000). Movement pattern, habitat utilization, home range size and site fidelity of whitesaddle goatfish, *Parupeneus porphyreus*, in a marine reserve. *Env. Biol. Fish.* **59**, 235-242.

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.

Mitamura H. (2005). Studies on the behavior of Mekong giant catfish using biotelemetry. *Kyoto University Doctor Thesis*, Kyoto University.

Mitamura H. Mitsunaga Y. Arai N. Viputhanumas T. (2006). Comparison of two methods of attaching telemetry transmitters to the Mekong giant catfish, *Pangasianodon gigas*. Zoological Science 23, 235-238

Nowlis J.S. Roberts C.M. (1999). Fisheries benefits and optimal design of marine reserves. *Fish. Bull.* **97**, 604-616.

Rainboth W.J. (1996). Fishes of the Cambodian Mekong. FAO; pp. 153.