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【Research Article】

Habitat Utilization of Largemouth Bass around a Set Net

Yasushi MITSUNAGA*1, Syunsuke KAWAI*2, Kazusoshi KOMEYAMA*3, Masanari MATSUDA*4 and Takeshi YAMANE*1

Abstract

To increase catch efficiency, it is necessary to understand the habitat utilization of the target fish around fishing gear. A biotelemetry study using coded ultrasonic transmitters and set receivers was conducted to understand the habitat utilization of largemouth bass around a set net in Lake Biwa, Japan. Three receivers were installed on leader nets of the set net at short intervals by design to understand the fine scale movement of fish. Four fish were implanted with a coded ultrasonic transmitter and released near the set net. Two fish were monitored for over 50 days and showed diurnal habits. Just before the fish left the set net, the main current direction was southwestward and the current velocity was over 5m/sec. In a set net fishery, current profile is an important factor affecting the concentration and dispersion of the target fish.

1. Introduction

Catch efficiency using passive fishing gear is affected by the habitat utilization of the target fish and environmental factors including ambient water temperature and water current[1)-4)]. Largemouth bass have been one of the dominant species caught by set nets called Eri in Lake Biwa since the 1990s (from Ukai, owner of a set net, a private note). To increase catch efficiency, it is necessary to understand the habitat utilization of the target fish around fishing gear. Biotelemetry is a powerful technique that provides continuous and simultaneous monitoring of fish behavior in their natural environment. Recently, because it is unnecessary to continuously track the fish by boat, a biotelemetry system using coded ultrasonic transmitters and set receivers is usually employed to observe the fish behavior for long periods[5)-8)]. However, studies using the system have rarely been conducted around fishing gear. In addition, because the setting intervals of receivers were longer than the detective distance, only information on the presence or absence of the fish in the detective zone was obtained. In this study, coded ultrasonic transmitters and set receivers were used to understand the habitat utilization of largemouth bass around a set net. The receivers were installed at shorter intervals than the detective distance by design to understand the fine scale movement of fish around the set net.

2. Materials and methods

The experiment was conducted around a set net installed at Shimo-sakamoto in the southern basin of Lake Biwa, Japan. The set net consisted of two 250m long reader nets straightened toward offshore. The arrangement of the set net is shown in **Fig. 1**.

Four fish captured by the set net were used for tracking. Details of each fish are given in **Table 1**. The fish were implanted with coded ultrasonic transmitters (Coded V8SC-6L, Vemco Ltd.). The transmitter weighed 2g in water, was 9mm in diameter, 20mm long and lasted 54 days. The transmitter emitted a train of six pings every 20±10 sec for identification[9)]. The implantation was conducted under anesthesia using 0.05% 2-phenoxyetanol and took about 10min. The fish were laied on their backs on an original operating table. The operating table was made of a folding chair attached a v-shaped panel on the x-shaped fold-

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*1 Department of Fisheries, Faculty of Agriculture, Kinki University, Nara 631-8505 Japan
*2 Graduate School of Science and Technology, Nagasaki 852-8521 Japan
*3 Graduate School of Fisheries Sciences, Hokkaido University, Hokkaido 041-8611 Japan
*4 Lake Biwa Museum, Shiga 525-0001 Japan

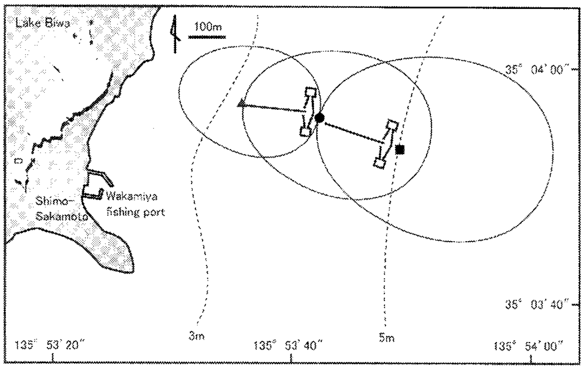

Fig. 1 The study area around a set net installed at Shimo-sakamoto in the southern basin of Lake Biwa, Japan.

Triangle, circle and square indicate an inshore receiver #1, a middle receiver #2 and an offshore receiver #3, respectively. Fish were released near the middle receiver and a current profile and temperature logger was installed with the offshore receiver. Egg shaped circles indicate the detection zone of each receivers. Dotted lines indicate the depth contours.

Table 1 Details of the largemouth bass examined.

Fish ID	Total length (cm)	Body weight (g)	Monitoring period (day)
105	34.0	600	102
106	35.0	640	56
107	35.5	650	1
256	37.0	640	17

ing legs and placed upside down in the fresh bubbling anesthetic solution. An incision of about 10mm was made on the abdomen of the fish and the transmitter was inserted. The wound was sutured with two stitches. After the operation, the fish were kept in a fish tank for 10 hours. The fish were released in the middle of the leader net on 3 December 2002 (**Fig. 1**).

Three set receivers (VR2, Vemco Ltd.) were installed in advance at intervals of 250m on the leader nets of the set net at 1 m from the bottom (**Fig. 1**). The receiver weighed 300g in water, was 60mm in diameter, and 205mm long. The receiver decodes the ID numbers of the fish implanted with the transmitters in the detection zone and records the number and time stamp in a flash memory. We conducted a preliminary study to identify the detection zone of the receivers around the set net. Another fish was implanted with a transmitter using aforementioned method and confined in a mesh bag. The fish was submerged and moved around the set net by boat and the position of the boat was recorded by GPS (Global Positioning System). Later, the records of each receiver were downloaded and the detection distance was determined by contrasting the detected time and the boat position simultaneously. A current profile and temperature logger (COMPACT EM, Alec electronics Ltd.) was installed at the offshore station to understand the environmental factors (**Fig. 1**). The records

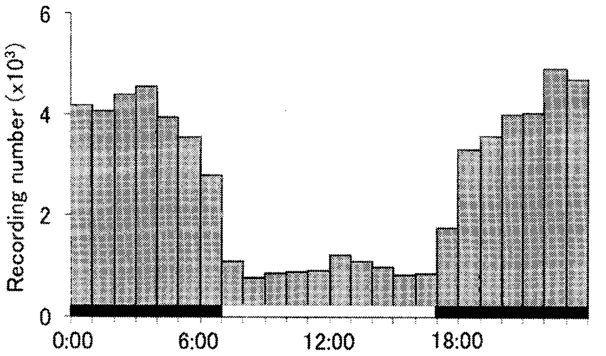

Fig. 3 The recording numbers of Fish ID 105 every hour through the tracking period.

Black and white bars indicate night and day, respectively.

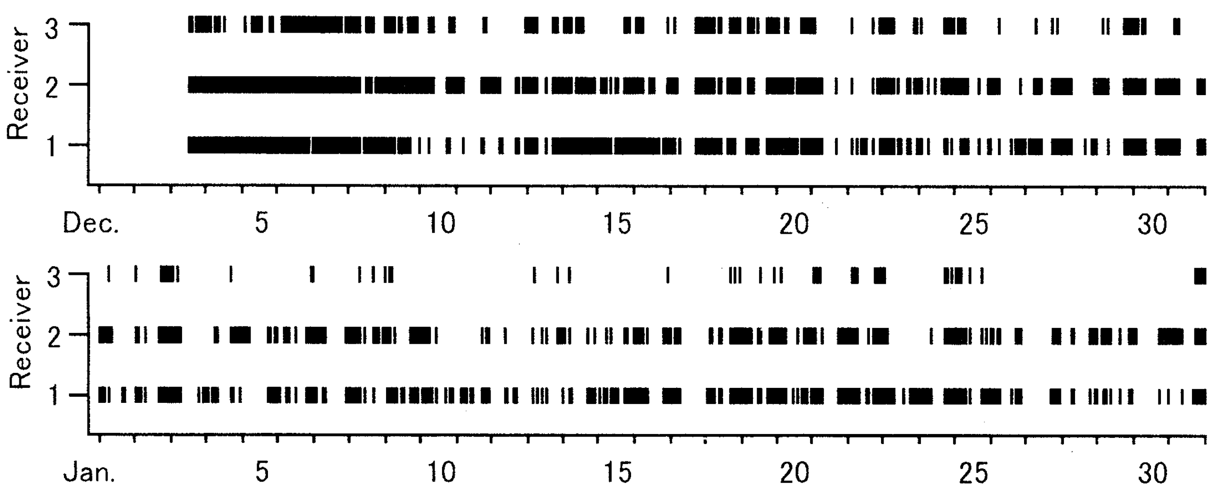

Fig. 2 Time series data of the appearance of Fish ID 105 from 3 December to 31 January.

Black bars show the recodes of receivers #1 to #3.

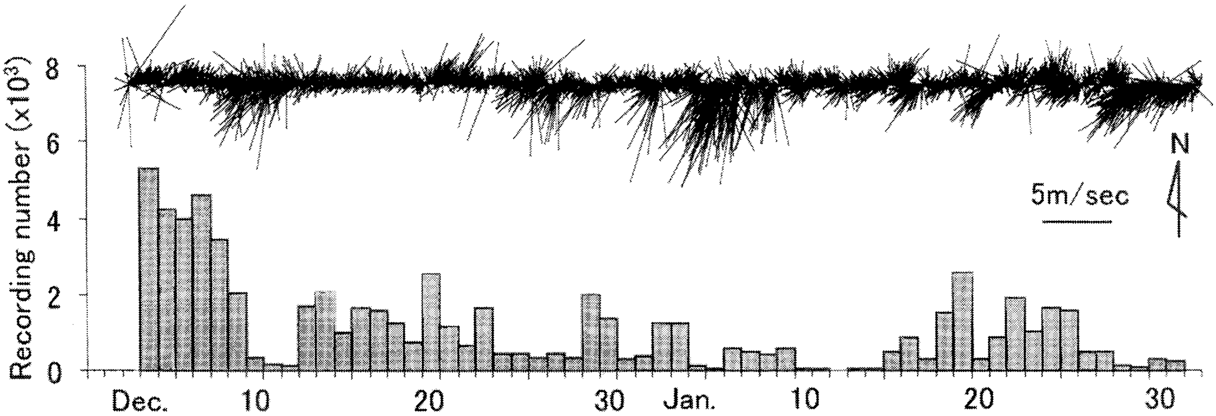

Fig. 4 Changes in daily recording numbers of Fish ID 105 and current profile as direction and velocity.

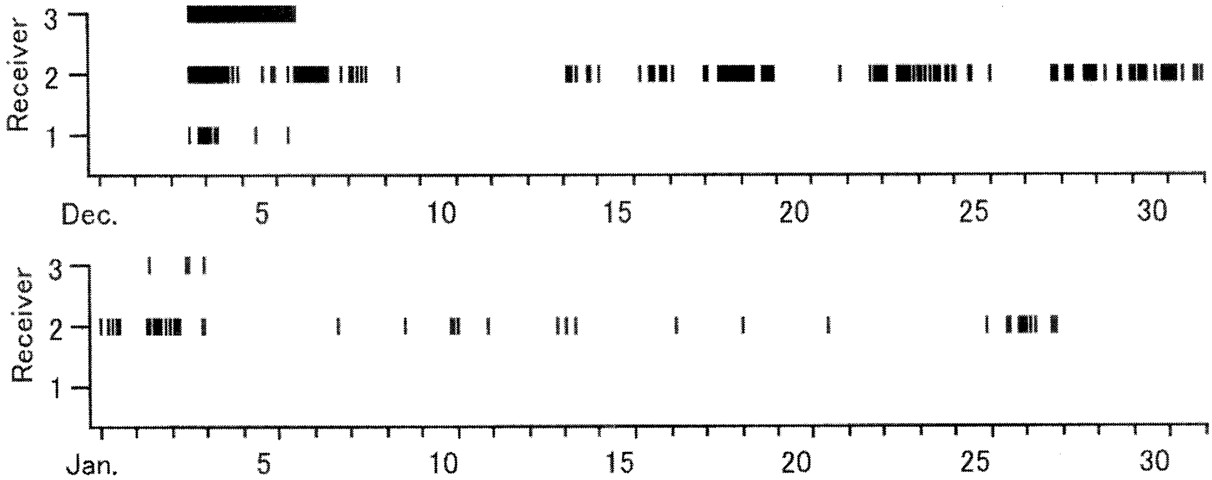

Fig. 5 Time series data of appearance of Fish ID 106 from 3 December to 31 January.
Black bars show the recodes of receivers #1 to #3.

were downloaded on 9, 24 December 2002, 31 January and 14 March 2003.

3. Results and discussion

The detection distances of the receivers around the set net were 150 to 240m. The distance tended to be longer the deeper they were offshore. It seems that inshore shallow sites include more noise than offshore deep sites. An outline of the detection zone of each receiver is illustrated in **Fig. 1**.

Fish ID 105, 106, 107 and 256 were monitored for 102, 56, 1 and 17 days respectively. Fish ID 107 left the set net just after release. The fish seemed to move inshore because an inshore receiver recorded the fish to the end of experiment. Fish ID 256 moved toward offshore after release. Then the records were only obtained by an offshore receiver intermittently.

Time series data of the appearance of Fish ID 105 are shown in **Fig. 2**. However, although the recording continued until 14 March 2003, the data till February were used for analysis because the battery life of the transmitter was expected to be about 60 days. The fish seemed to stay around the release point just after release because all receivers continued to record the fish simultaneously. The fish was considered to have moved toward inshore one day after release because the fish was not to recorded by an offshore receiver. Then the fish remained close to the set net for seven days. In the daytime on 11 December, the fish left the set net and no record was obtained by any receiver. In the evening on the same day, the fish came close to the set net again. Until the end of tracking, the fish generally showed the same pattern of daily movement whereby the fish left the set net in the daytime. The recording numbers of the fish every hour through the tracking period is shown in **Fig. 3**. The recording numbers at nighttime were significantly higher than those in the daytime (Wilcoxon signed rank test, $P < 0.01$). The occasional records in the daytime indicated that the fish did not stay in a certain position. Wildhaber and Neill also observed the diurnal habits of largemouth bass in a pond[10]. The ambient water temperature recorded by a temperature logger during the tracking period was bellow 10℃. Although largemouth bass prefer a temperature of 24 to 30℃[11, 12], the fish was relatively active in the daytime. Changes in daily recording numbers of the fish are shown in **Fig. 4**. The recording numbers declined on 10 December 2002, 4, 9 and 27 January 2003. Time series data of the current profile are also shown in **Fig. 4**. Just before the fish left the set net, the main current direction was southwestward and the current velocity was relatively high, over 5m/sec. This result indicates that the current profile affects the fish movement around the set net.

Time series data of the appearance of Fish ID 106 is shown in **Fig. 5**. The fish seemed to move toward offshore one day after release because the fish was recorded by an offshore receiver continuously and was not recorded by an inshore receiver. Then the fish remained around the middle of the set net until 27 January 2002. During the period, the fish was considered to move parallel to the shore because the records were only obtained by a middle receiver. If the fish moved toward inshore or offshore, the other receivers were expected to record the fish. Demers et al. also tracked largemouth bass and reported that the fish moved parallel to the shore[13]. Similar to Fish ID 105 but not so apparently, Fish ID 106 left the set net in the daytime. Finally, the fish moved away parallel to the shore and went missing on 27 January 2003. This was the same day that Fish ID 105 left the set net. Though the receivers installed at shorter intervals allowed the fine scale movement of fish to be understood, the arrangement of the receivers in this study could not clarify the direction of the fish movement, whether northeastward or southwestward as upstream or downstream. Varied arrangement of the receivers will clarify the direction. Added to this, there are ancient traditions concerning Eri whereby the catch variation is influenced by the current profile and parallel directions of the current produce a good catch (from Ukai, a private note). In this case, the parallel direction is southwestward or vice versa. In a set net fishery, the current profile is an important factor affecting the concentration and dispersion of the target fish. The approach direction of fish helps account for the capture process of passive fishing gear.

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エリ周辺におけるオオクチバスのテレメトリー追跡

光永　靖[*1]・河合修輔[*2]・米山和良[*3]
松田征也[*4]・山根　猛[*1]

和文要旨

琵琶湖固有の定置網であるエリ周辺で，コード化超音波発信機と設置型受信機を用いてオオクチバスを追跡した。オオクチバス4尾（TL：34.0～37.0cm）の腹腔内に発信機（Coded V8SCL, VEMCO製）を埋め込み，エリの中心に放流した。エリの垣網に設置型受信機（VR2, VEMCO製）3台を250mと敢えて間隔を狭めて設置し，詳細な移動を把握した。50日以上追跡した2尾は，10℃以下の低水温にも関わらず，昼間にエリから遠ざかり，夜間にエリに近づく日周移動を示した。同時にエリ周辺に設置した流向流速計の記録から，5m/sec以上の南西流が卓越した後，個体はエリから遠ざかったことが分かった。受動型漁具である定置網の漁獲には対象魚の移動と周辺の流動環境が密接に関わっていると考えられる。

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*1 近畿大学農学部水産学科　〒631-8505 奈良県奈良市中町3327-204
*2 長崎大学大学院生産科学研究科　〒852-8521 長崎県長崎市文教町1-14
*3 北海道大学院水産科学研究科　〒041-8611 北海道函館市港町3-1-1
*4 琵琶湖博物館　〒525-0001 滋賀県草津市下物町1091