SPECIAL REPORT

Hydroacoustic Monitoring of Anguillid Eels: a preliminary study

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Anguillid eels are widely distributed from tropical to subtropical areas. As a catadromous fish, anguillid eels spawn in the sea, migrate to freshwater as juveniles, and grow up before migrating back to the sea to spawn (**Figure 1**). Anguillid eel resources are ecologically, environmentally, economically, and socially important. However, the information and data on eel fisheries are limited; thus, the actual status and trend of anguillid eel resources could not be determined.

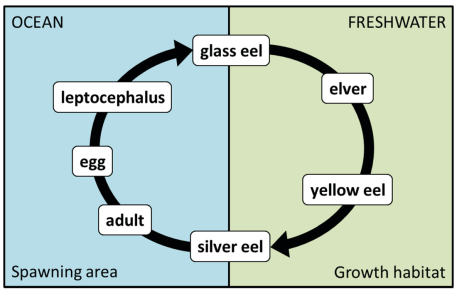

Figure 1. *Life cycle of anguillid eels*

In order to sustain eel fishery resources in the Southeast Asian region, IFRDMD implemented the project "Sustainable Utilization of Anguillid Eels in the Southeast Asian Region" from 2020 to 2024 supported by the Japanese Trust Fund VI Phase 2. The Project was intended to standardize the data collection system and map the genetic population structure based on the mtDNA approach in study areas including Indonesia, Philippines, Myanmar, and Viet Nam.

However, at the start of the COVID-19 pandemic in 2020, the data collection had become difficult when travel restrictions and lockdowns were imposed in countries around the world. Also, the enumerators could not collect any data since there was no demand for glass eels, juveniles, and yellow eels. To sustain data collection even during the COVID-19 pandemic, IFRDMD devised another method of data collection. In 2021, IFRDMD conducted a stock assessment to assess the current status of anguillid eel resources in Indonesia by using hydroacoustic technology to estimate the density and measure the target strength (TS) of anguillid eels.

Study sites

The hydroacoustic surveys were carried out in the Cimandiri River in Palabuhan Ratu, West Java and Serayu River in Cilacap, Central Java (**Figure 2**) which are endowed with abundant glass eels and yellow eels, respectively. The Cimandiri River flows about 100 km from east in Mount Pasir Caringin to west in the Indian Ocean in Pelabuhan Ratu (Hakim *et al*., 2016; Hartono *et al*., 2016). The Serayu River stretches about 181 km from northeast Wonosobo Regency to southwest in the Indian Ocean in Cilacap Regency (McNally, 1993).

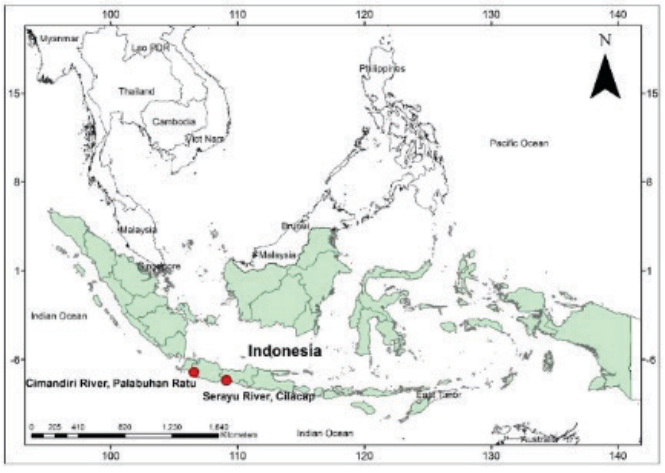

Figure 2. *Hydroacoustic surveys of anguillid eels in Cimandiri River in Palabuhan Ratu, West Java and Serayu River in Cilacap, Central Java in Indonesia (red dots)*

Anguillid eel density

For the estimation of anguillid eel density, hydroacoustic surveys were carried out during the rainy season. In the Cimandiri River, two surveys were conducted on 12 October 2021 at the daytime (11:29–15:15) and nighttime (19:20–20:48) covering 20.1 km of the river. In the Serayu River, the survey covered 6.2 km of the river on 11 November 2021 only during the daytime (11:12–13:24) due to inclement weather. During each survey, the acoustic device was placed at the side of the boat cruising at 3.8 km.

In the Cimandiri River, the total number of anguillid eels detected at nighttime (n = 1,206) was almost twice higher than the total number of anguillid eels detected in the daytime (n = 696). In the Serayu River, the total number of anguillid eels detected in the daytime (n =2,106) was three times higher than the total number of anguillid eels detected in the Cimandiri River in the daytime. The levels of anguillid eels density were categorized into low (0–1 individual/m^3), medium (2–3 individuals/m^3), and high (> 3 individuals/m^3). In the Cimandiri

River, high fish density was detected in the middle part of the river during daytime (**Figure 3A**) while high fish density was seen in the upstream area near the tributary of the river during nighttime (**Figure 3B**). In the Serayu River, high fish density was detected in the middle part of the river during daytime (**Figure 4**). The movement of the anguillid eels in the two rivers could be have been influenced by the sand mining activities during the day at the tributary at the Cimandiri River and at the downstream part of the Serayu River.

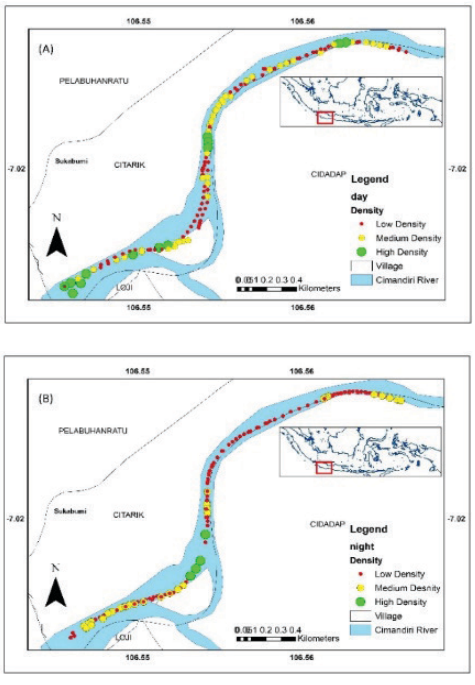

Figure 3. *Estimated density of anguillid eels in the Cimandiri River during the surveys at daytime (above) and nighttime (below)*

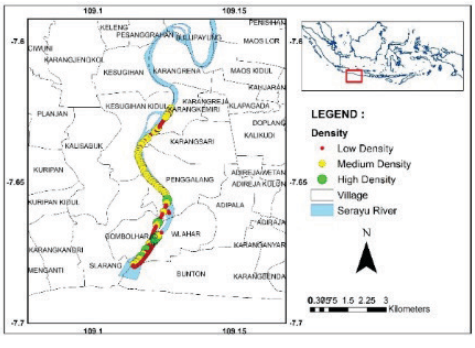

Figure 4. *Estimated density of anguillid eels in the Serayu River during the survey at daytime*

In addition, the number of fish detected in each elementary sampling distance unit (ESDU) from the middle part of the river to downstream was also recorded, where each ESDU is equal to 0.9 km. For the Cimandiri River, ESDU 1 was near the bridge and village area, ESDU 2 was around the agriculture area, ESDU 3 was near the tributary area, and ESDU 4 was in the estuary close to an electric power plant. During the daytime, the highest number of fish was detected at ESDU 1 (n = 239) and the lowest was at ESDU 4 (n = 81); while during nighttime, the highest number of fish was detected at ESDU 3 (n = 608) and the lowest was at ESDU 2 (n = 134) (**Figure 5**).

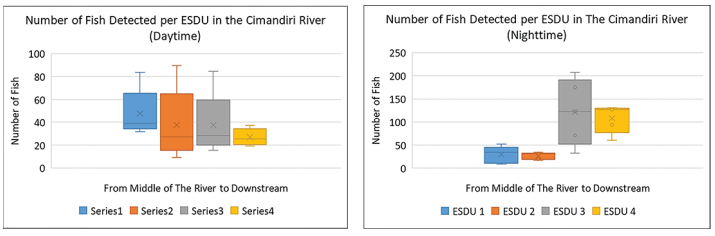

Figure 5. *Number of anguillid eels detected at each ESDU in the Cimandiri River during the daytime (left) and nighttime (right) surveys*

Target strength

The measurement of target strength (TS) of yellow eels (n = 6) sampled from the Cimandiri River was carried out to determine their response to acoustic instruments. The TS measurement was conducted based on Supriyadi *et al*. (2021) on 25 October 2021 at the laboratory of the Research Institute for Inland Fisheries and Extension in Mariana Banyuasin, South Sumatera. The body length, body weight, and swim bladder length of each fish were measured. Each fish was placed in the cylindrical fiberglass tank with a 2-meter diameter filled with water at 1.5 m depth to record the TS. The data were analyzed using the software Echoview 5.0 with a threshold setting of -70 dB, horizontal grid distance based on the time at 0.2 min, vertical grid separation at 0.2 m. The TS value was detected from (-52) to (-66) dB for yellow eels with the body length of 34–48 cm indicating that as the body length of anguillid eels increases the TS value also increases which is a directly proportional relationship.

Way Forward

The TS of other anguillid eel species would be measured to validate the preliminary data. Also, the acoustic surveys would be expanded to other locations.

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