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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF RIVER SPRAT, *Clupeichthys* sp. FROM TASIK KENYIR, TERENGGANU, MALAYSIA

MOHAMAD AQMAL-NASER[1], MUHAMMAD FAHMI-AHMAD[1] and AMIRRUDIN B. AHMAD[1,2*]

[1]Biology and Ecology Research (BERes), Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[2]Terrestrial Biodiversity and Aquatic Research (TeBAR), Institute of Tropical Biodiversity and Sustainable Management, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[*]E-mail: amirrudin@umt.edu.my

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ABSTRACT

The length-weight relationship (LWR) and condition factor for river sprat, *Clupeichtys* sp. from Tasik Kenyir was determined and qualitatively compared with the other known species within the genus in Southeast Asia. A total of 408 individuals were collected from the mouth of Sungai Cacing, one of the main feeder rivers in Tasik Kenyir. The total length of the individuals ranges from 2.80 to 4.60 cm, while their body weight ranging from 0.10 to 0.80 grams. The mean of the total length is 3.80 ± 0.32 while the mean for total weight is 0.50 ± 0.20. The growth pattern for this species was given by the *b* value of 2.94, which is slightly lower than that of the reported *b* values for *C. aesarnensis* (3.27 and 3.21) from Thailand, but higher than that of the reported *b* value for *Clupeichthys goniognathus* (2.67) from Indonesia. The relative condition factor was 1.01 ± 0.23, almost similar to other reported values for *Clupeichthys* spp. in Southeast Asia. This is the first report on the length-weight relationship and condition factor of river sprat from this genus in Peninsular Malaysia.

Key words: Allometric growth, *Clupeichthys*, condition factor, length-weight, Tasik Kenyir

INTRODUCTION

The length-weight relationship (LWR) and condition factor (K) of fishes is a common and useful analysis to estimate the health and growth of the fishes (Bagenal & Tesch, 1978; Adaka *et al*., 2015). However, due to the limited and laborious to collect enormous and continuous data from the field, the LWR analysis become crucial for fishery stock assessment (Froese, 2006; Ayoade, 2011). The conservation and management of fisheries resources also lie in the LWR information especially in a disturbed area in which the fisheries resources will be affected due to overfishing and habitat degradation (Francis, 2012). Besides, data and information such as growth and health of fish receive less interest among inland fisheries researchers in Malaysia and the data collection needs additional support especially research funding.

Studies of LWR on fishes in the reservoirs in Peninsular Malaysia are still limited. Several studies were conducted on the LWR of fishes at several reservoirs including Pedu (Isa *et al*., 2010) and Temengor (Muzzalifah *et al*., 2015). However, being the largest reservoir in Peninsular Malaysia, studies on the LWR of fishes from Tasik Kenyir only focus on the economically important and larger size species such as *Hampala macrolepidota* Kuhl & van Hasselt in van Hasselt 1823 (Zakaria *et al*., 2000; Kamaruddin *et al*., 2012) and *Barbonymus schwanefeldii* (Bleeker 1854) (Kamaruddin *et al*., 2012). From the results, *H. macrolepidota* exhibit isometric to negative allometric growth while *B. schwanefeldii* demonstrated negative allometric growth. Beyond this, the information regarding the LWR of fishes especially in Tasik Kenyir is still poorly known.

All river sprats or freshwater anchovies in Peninsular Malaysia are referring to the genus *Clupeichthys*. In Peninsular Malaysia, the presence

* To whom correspondence should be addressed.

of the river sprat has been reported from Sungai Perak (Herre & Myers, 1937; Whitehead, 1988; Radhi *et al*., 2017; Zakaria-Ismail *et al.*, 2019) on the west coast and Sungai Pahang (Lim & Tan, 2002) on the east coast of Peninsular Malaysia. The species from Sungai Perak is known as *C. perakensi*s (Herre, 1936) and was harvested for local consumption mainly in the northern part of Perak state. The distribution of the species is limited to Sungai Perak drainages (Kottelat & Whitten, 1996; Ng *et al*., 2019; Zakaria-Ismail *et al.*, 2019) but the information regarding its LWR and condition factor remains unknown. Another clupeid was reported from Sungai Pahang is tentatively identified as *C.* cf. *aesarnensis* by Lim and Tan (2002). Little is known about this fish and it is neither widely caught nor reported consumed like its congener from Sungai Perak.

Previously, several fish inventories were conducted at Tasik Kenyir, which had successfully recorded the presence of river sprat such as by the Department of Fisheries Terengganu (DOF) (1994) and Yusof *et al*. (1995), and it was reported as *Corica* sp. Subsequently, Zulkafli and Ashhar (2000) also recorded the presence of this species at Tasik Kenyir and reported it as *Clupeichthys aesarnensis* commonly known as the Thai river sprat. To date, *C. aesarnensis* Wongratana 1983 is known to be restricted in the reservoirs and rivers of Vietnam, Cambodia, Laos, and Thailand (Whitehead, 1985; Poungcharean, 2006; Di Dario, 2018). This species is one of the important inland fisheries resources in the north-eastern part of Thailand. They are nocturnal pelagic fish, schooling to feed on the zooplankton at night (Termvidchakorn, 2003).

In the recent fish survey, we collected fish specimens of river sprat from Tasik Kenyir reservoir, Terengganu. The exact identity of this species is yet to be determined and we believe it represents another species that differ from any known *Clupeichtys* in this region, especially in Peninsular Malaysia (Figure 1). The utilization of clupeid species from Tasik Kenyir for inland fisheries has never been reported before and no LWR information was found in the works of literature. We take the opportunity to determine the LWR and condition factor of the least known river sprat, *Clupeichthys* sp. at Tasik Kenyir, Terengganu, and the results are presented in this paper.

MATERIALS AND METHODS

Study site, sampling method, and measurements

Fish specimens were opportunistically sampled from the mouth of Sungai Cacing (04º482 242 2 N, 102º462 302 2 E), one of the main rivers that flow into Tasik Kenyir (5°02’20.1"N 102°44’29.4"E) (Figure 2). A total of 408 fish were caught using the long handle scoop net (mesh size of 0.5 cm) while they were schooling at the littoral zone of the lake between dawn and midnight. The collected fish was euthanized in tricaine (MS222), and all 408 individuals were measured for their total and standard length (TL and SL, cm), and wet weight was taken after patted dry using tissue paper to the nearest gram. Ten individuals were preserved in 10% formalin as voucher specimens and later were transferred into 70% ethanol solution for long-term storage. The specimens were then deposited in Universiti Malaysia Terengganu Zoological Collection (UMTZC).

Fig. 1. Preserved specimen of *Clupeichthys* sp. (4.0 cm in total length) from Tasik Kenyir, Terengganu, Peninsular Malaysia.

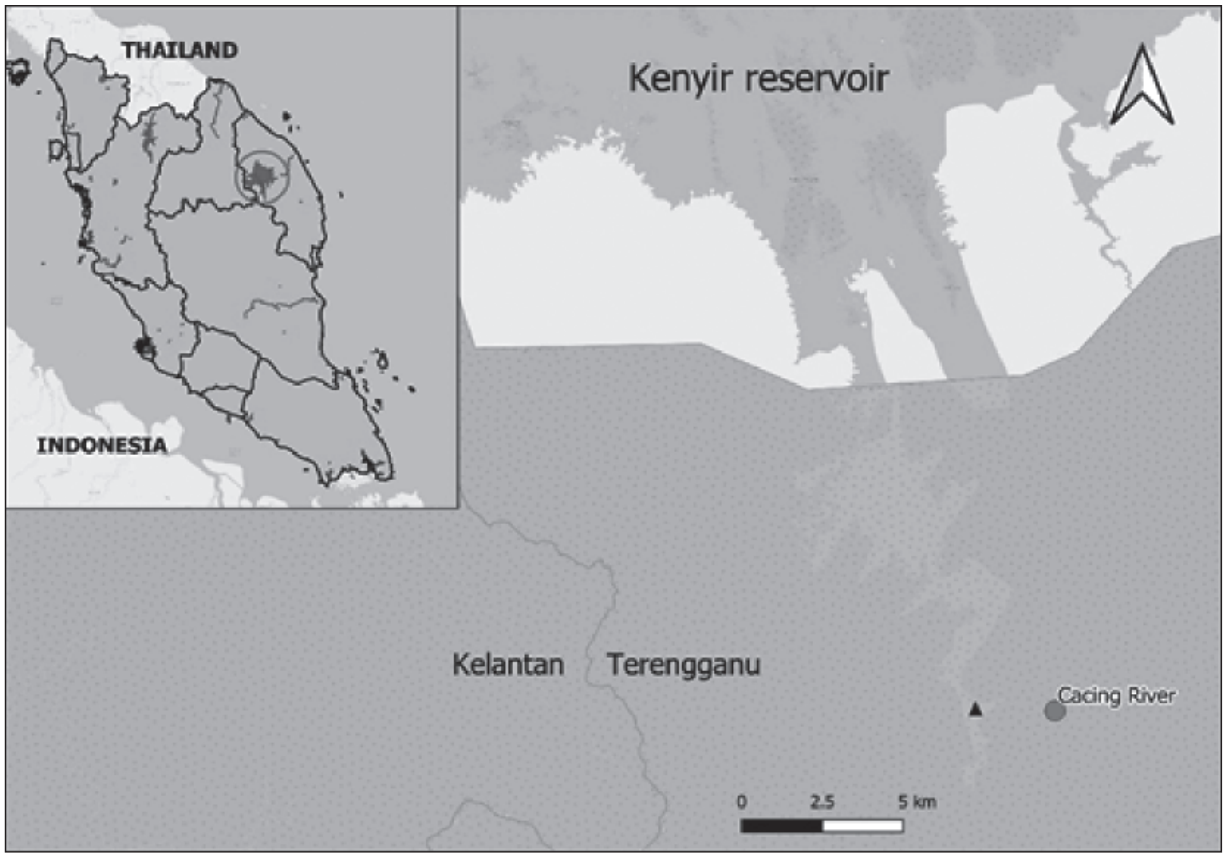

Fig. 2. The map of Peninsular Malaysia (inset) showing the location of Tasik Kenyir (denoted by a hollow red circle) in the eastern part of Peninsular Malaysia, and the enlarged map shows the site of data collection (black triangle) in the mouth of Sungai Cacing.

Length-weight relationship (LWR)

Both LWR and condition factors are the principal tools to assess the health of fishes. LWR enables the estimation of the weight (W) of the fish using a given length (L) while the condition factor (K value) is used to represent the well-being of the fish. The LWR was given by the formula:

$$W = aL^b \qquad \text{Equation 1}$$

W is the weight of the fish, L is the length of the fish, the value "*a*" is an intercept from the graph, and "*b*" is the slope of the graph (Ricker, 1973). The equation was then transformed into a logarithmic equation following Le Cren (1951) as:

$$\text{Log } W = \text{Log } a + b \text{ Log } L \qquad \text{Equation 2}$$

Relative condition factor (Kn)

The relative condition factor (Kn) is determined based on the empirical LWR and calculated using the equation from Le Cren (1951):

$$Kn = W/aL^b \qquad \text{Equation 3}$$

Where W is the weight of the fish, L is the total length of the fish. The relative condition factor measures the deviation of the individual from the average weight within the sample. We did not use the Fulton condition factor as the formula is more appropriate in determining the condition factors between the populations (Froese, 2006).

The *b* value is useful to determine the growth condition of the fish. The value of $b=3$ indicates isometric growth where the length and weight increase proportionally, while $b<3$ denotes negative allometric growth when the length increases faster than weight, and $b>3$ represents positive allometric growth in which the weight increase faster than length.

RESULTS AND DISCUSSION

The general analysis of total length (TL) and weight of *Clupeichthys* sp. from Tasik Kenyir ($n=408$) showed that the TL of the species ranged within 2.8 to 4.6 cm, while the body weight ranged from 0.10 to 0.80 g respectively (Figure 3). In Peninsular Malaysia,

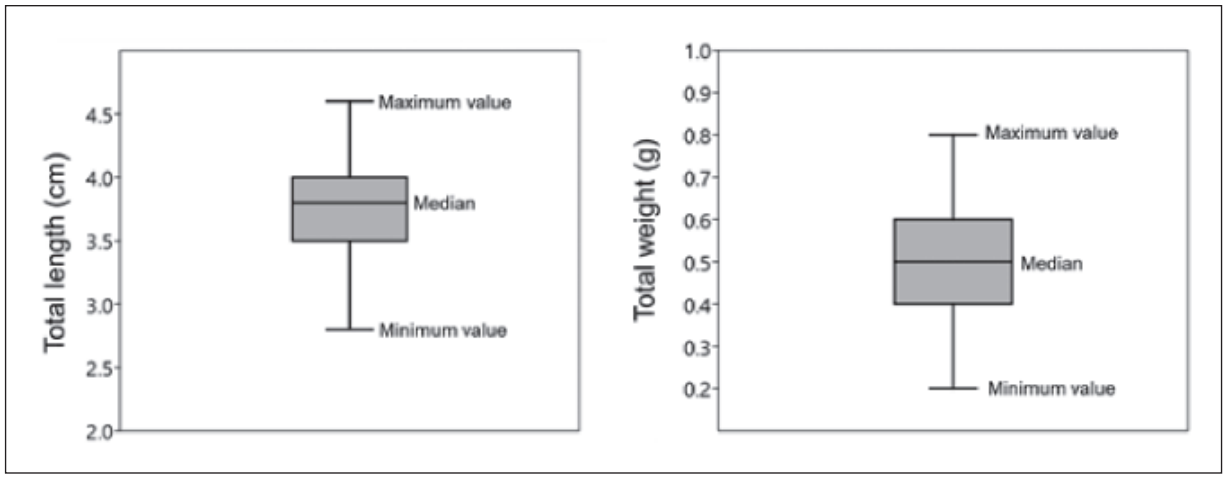

Fig. 3. Boxplot of total length, TL (cm) (left), and weight (g) (right) of *Clupeichthys* sp. (*n*=408) from Tasik Kenyir.

according to Di Dario (2018), *C. perakensis* is a bycatch for human consumption and the size usually ranges from 3.00 to 4.70 cm TL (Radhi *et al*., 2017). The TL of the fish caught from Kenyir was almost the same size as those from Sungai Perak. However, the maximum TL of the specimens collected from Tasik Kenyir is shorter than that of *C. aesarnensis* reported from several locations in Thailand (Sirimongkontaworn & Fernando, 1994; Jutagate *et al*., 2003) as well as Laos (Morioka *et al*., 2019). The *Clupeichthys* sp. from this study has 13-14 dorsal-fin rays compared to *C. aesarnensis* (11-12), *C. perakensis* (12-18), and C. *goniognathus* (12-18), and 15-16+2 anal fin rays (vs. 14-16+2 in *C. aesarnensis*, 14+2 in *C. perakensis* and 15-17+2 in *C. goniognathus*) (see Wongratana, 1980). The biggest specimen of fish at Tasik Kenyir was also smaller than that of *C. goniognathus* reported by Whitehead (1988) and Rainboth (1996).

The "*b*" value from Equation 2 for the specimens from Tasik Kenyir was lower than that of *C. aesarnensis* but about equal to *C. goniognathus*. Fish from Tasik Kenyir showing negative allometric growth, similar to *C. goniognathus* Bleeker, 1855 (Figure 4). The relative condition factor (Kn) or the well-being of *Clupeichthys* sp. From Tasik Kenyir in this study was in the mid barrier (1.01 ± 0.23), between good growth; well proportioned (Kn value more than 1.00) and poor growth; long and thin (Kn value less than 1.00) (Figure 5). According to Barnham and Baxter (1998), poor growth fish body was defined as long and thin fish. Condition factor recorded for fishes from Tasik Kenyir was considered having an intermediate growth, unlike the other two previous species which showing good and well-proportioned growth. A study by Sirimongkontaworn and Fernando (1994) also found that *C. aesarnensis* has a condition factor of 1.53 ± 0.03, which is a well-proportioned fish. Poor growth condition of the fish is related to the food availability and as a result of overpopulations (Blackwell *et al*., 2000). It was said that the changes in plankton quality and quantity had led to the poor growth of some marine anchovies and sardines (Breosset *et al*., 2015), while the mortality rate depends on the fishing intensity and weather (Jutagate *et al*., 2003).

The colonization of the clupeid is often associated with the food availability of the area. For instance, the Malabar sprat *Ehirava fluviatilis* Deraniyagala 1929, had successfully colonized some of the freshwater reservoirs in Sri Lanka as the presence of their preferred food including the micro-crustaceans (Mihindukulasooriya & Amarasinghe, 2014). At Tasik Kenyir, zooplankton such as copepod and cladocerans were abundant especially in the lentic zone (Kamaruddin *et al*., 2010). Plus, the lentic environment of Tasik Kenyir recorded the denser population of phytoplankton with a total of six divisions (Latif *et al*., 2014). The river sprat such as *C. aesarnensis* fed on the larger zooplankton especially cladocera, and others including dead insects as well as their own young (Sirimongkontaworn & Fernando, 1994). Thus, river sprat should be able to sustain and maintain the food sources since the phytoplankton at Tasik Kenyir was plentiful.

A simple comparison of "*b*" values (Figure 4) and relative condition factors (Figure 5) was made between *Clupeichthys* sp. from Tasik Kenyir, *C. aesarnensis,* and *C. goniognathus* based on the information obtained from previously published literature. The "*b*" values estimated for *Clupeichthys* sp. from Tasik Kenyir in this study (2.94) were lower than that of the two previous species in several reservoirs in Thailand (see Sirimongkontaworn & Fernando, 1994; Jutagate *et al*., 2003). The fish from Tasik Kenyir has negative allometric growth compared to the species from Thailand which has

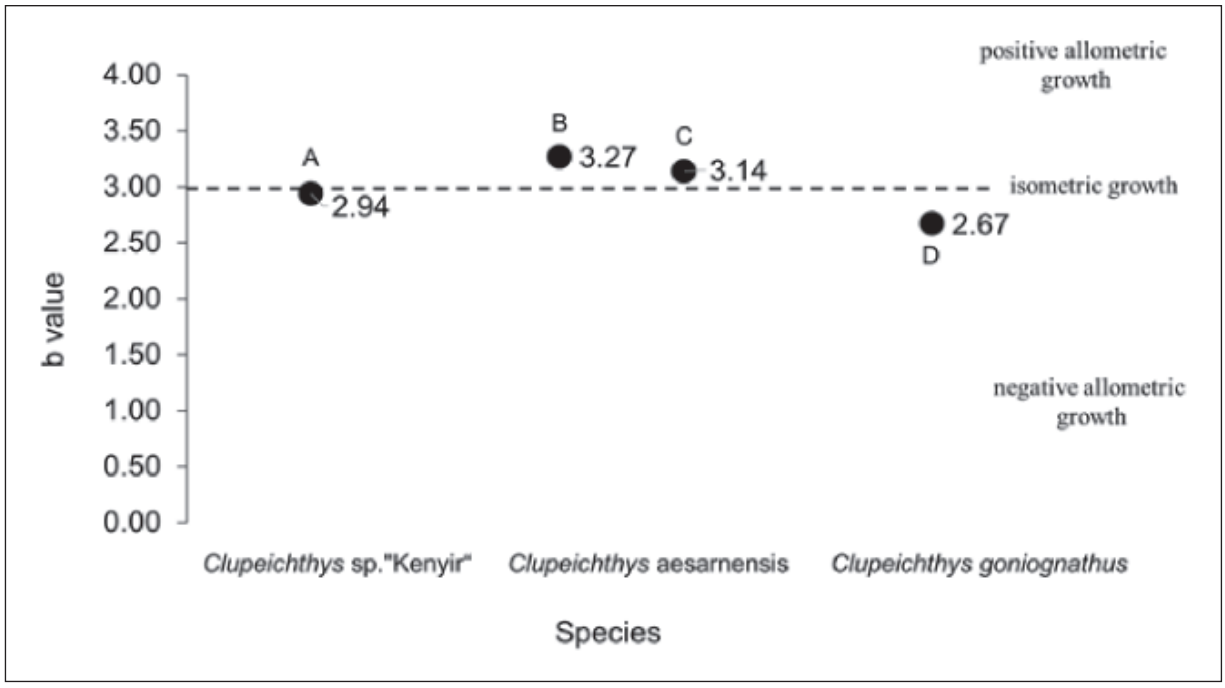

Fig. 4. A comparison of *b* values between *Clupeichthys* sp. "Kenyir", *C. aesarnensis* and *C. goniognathus* from previous studies where the letters A represent the current study, B was from Sirimongkontaworn and Fernando (1994), C was based on the report of Jutagate *et al*., (2003) and D was from Desrita (2011).

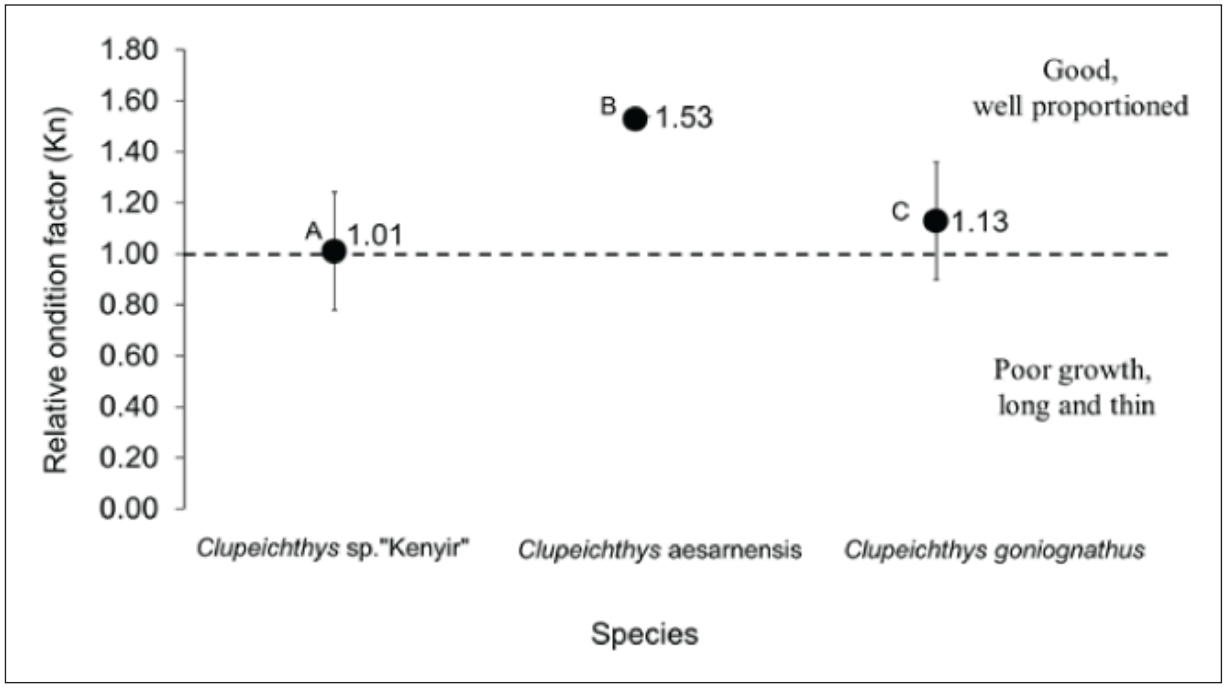

Fig. 5. A comparison of relative condition factors between *Clupeichthys* sp. from Tasik Kenyir, *C. aesarnensis,* and *C. goniognathus* from previous studies where the letters A denote the present study, B was from Sirimongkontaworn and Fernando (1994) and C was from Desrita (2011). The standard deviation of the relative condition factor for B was not visible due to the very small values computed compared to A and C.

positive allometric growth (Sirimongkontaworn & Fernando 1994). The differences between the LWRs of these species could be because of different species' ecology and physiology and probably related to the physical environment where the species live. For example, it was known that the higher water temperature induced the early maturation and affected the size of *C. aesarnensis* between Sirindhorn Reservoir, Thailand, and Nam Ngum Reservoir, Laos (Morioka *et al*., 2019). Further study is needed to determine what drives the ecology and physiology of river sprat at Tasik Kenyir.

Little is known about the ecology of river sprats in Malaysia which could be one of the species that urgently need to be studied. Given that the fisheries resources at Tasik Kenyir now facing a huge reduction of resources compared to the past (Aqmal-Naser & Ahmad, 2020), this species can be exploited and may become one of the alternatives to sustaining fisheries to supply a cheap protein source for the locals. It is also known that the river sprat, *C. aesarnensis* has a short life span (about nine months), it also has continuous recruitment throughout the year (Sirimongkontaworn & Fernando, 1994; Jutagate *et al*., 2003), which explained the higher abundance of its population in the reservoirs. Although no information is known for the river sprat at Tasik Kenyir, it is expected that the *Clupeichthys* sp. from Kenyir might also have similar ecology and reproductive strategy as its congener in Thailand. Nevertheless, continuous surveys and studies regarding the population size of this river sprat should be carried out to further determine its potential as additional fisheries resource species in Tasik Kenyir.

CONCLUSIONS

Our study has established the addition and expansion of pivotal knowledge on river sprat, from the genus *Clupeichthys* with additional information on LWR and Kn of the species from Tasik Kenyir, Malaysia. This report is also the first on LWRs and relative condition factor of river sprat in Peninsular Malaysia and will be very useful as a potential guide for fisheries resources utilization as well as for the conservation and management of this species.

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