Short Communication:
Length-weight relationships of yellowfin and bigeye tuna from the South China Sea

Nguyen K.Q.1,2*; Phan H.T.1; Do T.V.1,3; Nguyen B.V.1,4; Tran P.D.1; Nguyen L.T.1; To P.V.1; Vu N.K.1

1-Nha Trang University, 2 Nguyen Dinh Chieu, Nha Trang, Vietnam
2-Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre, 80 East White Hills Road, St. John’s, NL, A1C 5X1, Canada
3-Research Institute for Marine Fisheries, 224 Le Lai, Hai Phong, Vietnam
4-Vietnam Tuna Association, 9 Nguyen Dinh Chieu, Nha Trang, Vietnam
*Corresponding author's Email: khanhqn@ntu.edu.vn

Keywords: Yellowfin tuna, bigeye tuna, length-weight relationships, offshore fishery

Introduction
Tuna has become the most important commercial fishery and a major economic contributor to Vietnam's central provinces such as Khanh Hoa, Phu Yen, and Binh Dinh (Nguyen et al., 2013; Nguyen and Jolly, 2018). Landings in 2019 were 16,207 metric tons accounting for USD $720 million in exported value, corresponding with 13.3% exported value of marine fisheries (VASEF, 2020). Historically, tuna were caught using longline targeting yellowfin and bigeye species, however fishermen have switched using handlines with artificial light since 2012 due to higher catching performance (Nguyen and Tran, 2014). The tuna resource is exploited year-round, on offshore fishing grounds in the South China Sea (Nguyen et al., 2013).

Given important tuna fishery in Vietnam, developing effective management guidelines for yellowfin and bigeye tuna is difficult because very little biological and demographic information has been documented (WCPFC, 2011). The study on the LWR is necessary and a primary process in order to conduct studies on fish stocks assessment.

Materials and methods
Tunas were collected in the South China Sea using gillnets and handlines with artificial light. All fishing gillnets were deployed and retrieved onboard the commercial F/V KH97939TS, measuring 18.47m LOA from March 25 to April 14, 2019. The experimental gillnets were 960 m in length and 44.7 m in height with 160 mm stretched mesh sizes. Handlings sampling was carried out onboard the commercial F/V BD95930TS, measuring 15.7 m LOA between March 26 and July 12, 2019 with 10 days break each month (from 11th to 19th of lunar month) to avoid low catch rates during the full moon phases.

All tunas captured by handlines and a majority of tunas captured by gillnets were weighted totally (wet weight).
nearest 0.1 kg and measured total length (TL) nearest cm. The LWRs were estimated using a linear regression, following the equation log \( W = \log(a) + b \log(TL) \), after logarithmic transformation from the equation \( W = a TL^b \), where \( W \) is the weight, TL is the total length, \( a \) is the intercept and \( b \) is the slope of the power equation. Prior to fitting regression analysis, outliers were examined and removed using log(\( W \)) versus log(\( TL \)) plots (Froese, 2006). Log(\( a \)) and \( b \) were performed using function \( y = \text{lm} ( \log(W- \log(TL, \text{data=Dat}) \), and the 95% confidence interval (CI) were estimated using \text{confint} \) function in R. Additionally, the

\[
W_Y = 0.0000198 TL^{2.973} \quad (\text{CI: } a = 0.0000156 - 0.0000251, b = 2.922 - 3.023), \quad R^2 = 0.971 \\
W_B = 0.0001359 TL^{2.61} \quad (\text{CI: } a = 0.0001064 - 0.0001736, b = 2.555 - 2.665); \quad R^2 = 0.977
\]

for yellowfin and bigeye tunas, respectively. The regression analysis of all LWRs were statistically significant for both species (\( p < 0.0001 \)). There were significant differences in LWRs between species (Kolmogorov-Smirnov two-sample test, \( D = 0.22, p < 0.0001 \)), in that bigeye tuna were about 5 kg heavier than yellowfin tuna at the same length when they were from about 70 cm long.

Although sustainable exploitation of yellowfin and bigeye tunas would have clear benefits, developing effective management guidelines for these species is difficult because there is no information on its biological characteristics (WCPFC, 2011). The first time the LWR parameters for yellowfin and bigeye tunas, an very important commercial species in the waters of Vietnam were documented. This study filled the scientific information gaps in elementary biological knowledge and provided useful information of ichthyofauna to support to the further sustainable fisheries development and management.

The values of \( b \) for both species fell in the expected range, 2.5 – 3.5 (Froese, 2006). In this study, we sampled fish larger than 41 cm, the coefficient of determination (\( R^2 \)) could be improved and the regression model estimated a greater accuracy for \( \log(a) \) and \( b \) values if there were a full range of fish length including fish < 41 cm (Froese, 2006). While parameters \( a \) obtained from our study were consistent with studies conducted in other areas, \( b \) values were
slightly smaller than those estimations (Cort et al., 2015). Several factors affect the accuracy of the LWR, i.e. condition of fish caught in different seasons, sex, length range, sample sizes, stomach fullness, and fitting methods (Froese, 2006). Therefore, these differences in $b$ values could be attributed to a single factor or to a combination of multiple factors (Cort et al., 2015).

Acknowledgements
We are grateful to the skippers and crew members on KH97939TS and BD95930TS for invaluable assistance and help with data collection. We thank the Institute of Marine Science and Fishing Technology of Nha Trang University and the Research Institute for Marine Fisheries for providing the means to deploy this study.

References


