INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 22, No. 3, p. 24-29, 2023

RESEARCH PAPER OPEN ACCESS

Length-weight relationship and condition factor of four-wing flying fish, *Hirundichthys affinis* from the west coast of Surigao del Norte, Philippines

Jane De Asis, Ilaiza M. Manadong, Earl Camille H. Perez, Anna B. Polina, Bernard C. Gomez*, Teofanes L. Apac

Surigao del Norte State University – Malimono, Campus, Malimono, Surigao del Norte, Philippines

Key words: Four-wing flyingfish, Length-weight relationship, Condition factor, Growth pattern

http://dx.doi.org/10.12692/ijb/22.3.24-29 Article published on March 04, 2023

Abstract

The length-weight relationship and condition factor of four-wing flyingfish, *Hirundichthys affinis* from the west coast of Surigao del Norte, Philippines was studied for three months from December 2022 to February 2023. A total of 252 samples were collected, measured, and analyzed in the laboratory of Surigao del Norte State University-Malimono Campus. The formula $W = aL^b$, which was transformed into the logarithmic form Log W = Log a + b Log L, was used to estimate the length-weight relationship. The growth coefficient *b* found ranged from 3.099 to 3.121, showing positive allometric growth. The correlation coefficients (R^2) for the period of December 2022 to February 2023 were 0.9148, 0.9441, and 0.9354, respectively, demonstrating a strong relationship and high degree of correlation between the fish's length and weight. The four-winged flying fish species in this study were in good condition, as indicated by the relative condition factor (Kn), which ranged from 1.00 to 1.02.

* **Corresponding Author:** Bernard C. Gomez ✉ nardgomez2020@gmail.com

Introduction

The four-wing flying fish, *Hirundichthys affinis* belongs to a family of flying fish known as Exocoetidae. It can be found throughout the western tropical Atlantic (Khokiattiwong *et al*., 2020), and has been spotted off the coast of Surigao del Norte in the Philippines (Gomez *et al*., 2019). Flying fish including smaller ones are being caught using modified surface encircling nets and surface drift gillnets, which provide a source of income for many Filipino fishermen (Gomez, 2020). Flying fish fishery in the Philippines is in an unsustainable state and showed a decreasing abundance (Emperua *et al.,* 2017).

The length-weight relationship (LWR) is one of the crucial evaluation techniques for the sustainable exploitation and management of the fish population. LWR is useful for the prediction of weight from length values, condition of fish, stock assessment, and estimation of biomass (Petrakis and Stergiou, 1995; Vaslet *et al*., 2007). Additionally, they are used to gather data such as biomass from length frequency distribution (Anderson and Gutreuter, 1983; Gayanilo *et al.,* 1997). The parameters of the LWR of fishes are of primary importance in fishery assessment and management (Garcia *et al*., 1998).

LWR and condition factors are also used to evaluate the current state of the species and serve as an indicator of changes in fisheries. Kasimoglu (2014) also reported that the condition factor is employed as an indicator to evaluate environmental changes. Thus, this study was conducted to determine the length-weight relationship and condition factor of four-wing flying fish sampled from the west coast of Surigao del Norte, Philippines. The findings of this study could offer information for preserving the natural populations of this significant fishery resource.

Materials and methods

Study Area

The study was conducted on the western coast of Surigao del Norte for three months, from December 2022 to February 2023, following the sampling stations used by Gomez *et al.* (2019). Station 1, 9° 2' 55.45" N, 125° 23' 45.19" E (Linongganan), Station 2, 9° 38' 26.54" N, 125° 23' 42.27" E (Cagtinae), and Station 3, 9° 34' 43.70" N, 125° 24' 43.09" E (Cansayong). The sampling stations are landing points for fishing boats engaged in catching flying fish (Fig. 1).

Sampling procedures

The four-wing flying fish species were selected regardless of their size from the three (3) sampling stations. The samples were kept chilled in an ice box until they were brought to the Surigao del Norte State University-Malimono Campus laboratory for analysis. The total length was determined using a fish board measured to the nearest 0.1 cm. Moreover, body weight was also recorded to the nearest 0.01 gram using a 500g x 0.01g electronic digital scale. The measurement does not include samples with broken tails.

Statistical analysis

The length-weight relationship was calculated using the equation $W = a L^b$ (Pauly, 1984), which was then transformed into the logarithmic form Log W = Log a + b Log L; where *W* is the weight of fish in grams, *L* is the total length in centimeters, *a* is the intercept which describes the rate of change of weight with length, and *b* is the slope of the regression line.

The formula of (Pauly, 1983) was used to compute the condition factor to show the degree of the well-being of the fish in their habitat: Condition Factor (K) = $100W/L^3$; where *W* is the weight (g) and *L* is the total length (cm).

The relative condition factor (K_n) was calculated to assess the condition of each fish individual using the equation of (Le Cren, 1951). $Kn = W/axL^b$; where (Kn) is defined as Wo/Wc, where Wo is the observed weight, and Wc is the calculated weight from the length-weight relationship. Minitab 17 and Microsoft Excel 2016 were used in processing and analyzing the data.

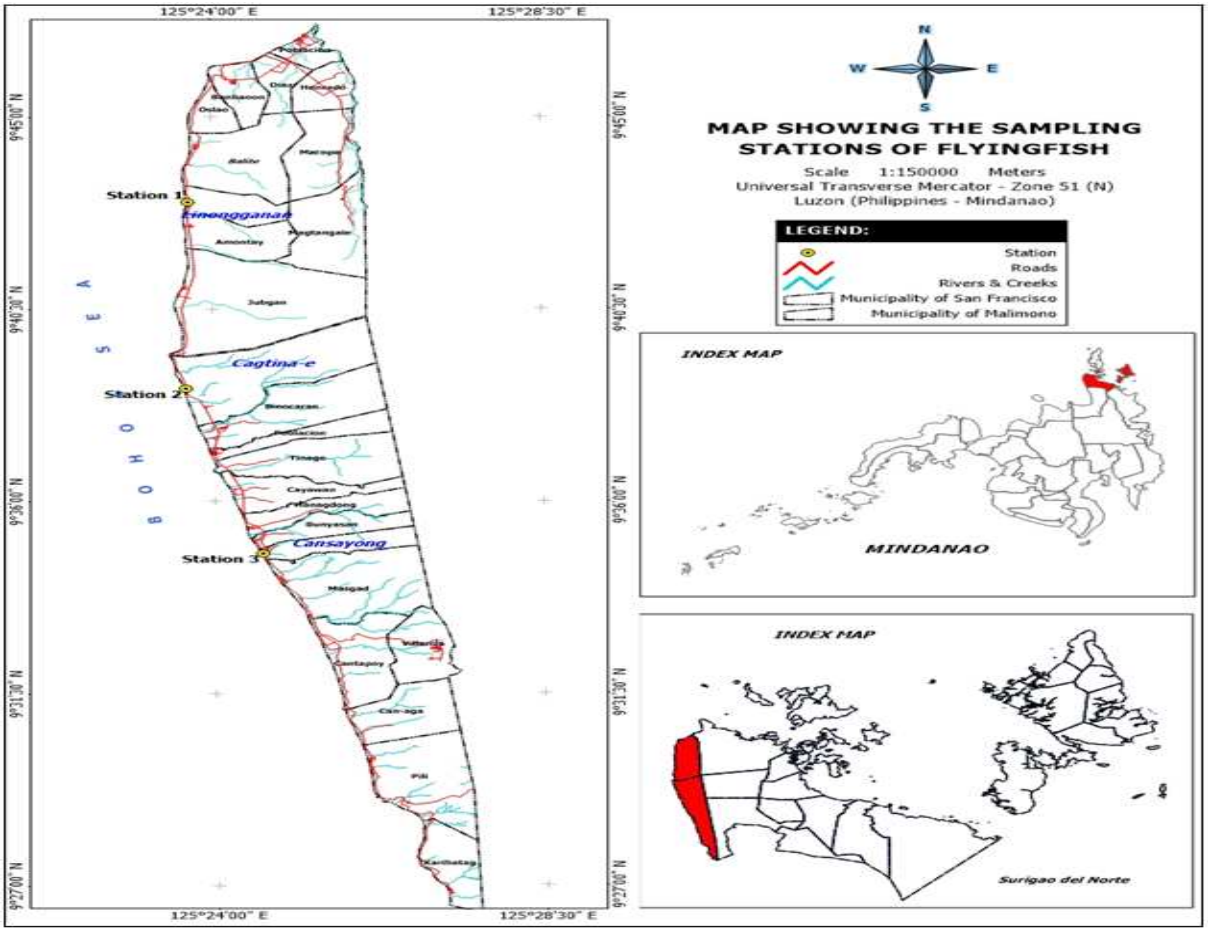

Fig. 1. Location map of the study area on the west coast of Surigao del Norte, Philippines.

Results and discussions

Length-weight Relationship

Sample size, minimum and maximum length and weight, parameter estimates, growth pattern, and determination coefficients (R^2) from non-linear regressions of the four-wing flying fish sampled from the west coast of Surigao del Norte, Philippines are shown in Table 1. The result revealed that the *b* values were slightly increasing from December 2022 to February 2023, and exhibiting positive allometric growth. This means that the weight of four-wing flying fish increases more than the length (b > 3).

Table 1. Length-weight relationship of the four-wing flying fish, *H. affinis* from west coast of Surigao del Norte, Philippines

Month	n	Length (cm)	Weight (g)	a	b	R^2	Growth Pattern
December	93	15.0-24.5	23.3-103.3	0.0053	3.099	0.9148	PA
January	71	17.5-25.8	35.2-137.5	0.0054	3.103	0.9441	PA
February	88	17.6-25.6	42.3-136.3	0.0052	3.121	0.9354	PA
Pooled Data	252	15.0-25.8	23.3-137.5	0.0042	3.1854	0.9621	PA

PA-Positive Allometry.

Ibrahim (1984) reported that a fish gets fatter when the value of *b* exceeds 3 and gets thinner when the value of *b* is less than 3. Further, body form remains constant in relation to the length when the length-weight exponent *b* is equal to 3.0, and the fish grows isometrically as a result, giving it an ideal shape (Pauly, 1983). The increasing *b* values of four-wing flying fish in this study were due to the gonadal development of the species. The majority of the samples collected have eggs in the ovary. Gomez *et al.*

(2019) stated that the fecundity of the flying fish linearly increases with the increase in ovary weight which resulted in an increase in body weight. They also observed that yellow-wing flying fish, *C. phoesilopterus,* and other flying fish species spawned in the months of February to May with the spawning peak in March on the west coast of Surigao del Norte, Philippines. Mahon (1986) also found out that the four-wing flying fish, *H. affinis* spawns in the Northeastern coastal waters of Brazil throughout the fishing season (December–June), and shows a peak in spawning activity from March to June.

Table 2. Mean ± SD of total length (cm), body weight (g), and mean relative condition factor (K_n) of four-wing flying fish, *H. affinis,* December 2022 to February 2023.

Month	n	Total Length	Body Weight	K_n
December	93	18.52 ±2.41	47.86±20.42	1.02
January	71	22.13 ±2.16	83.51±23.78	1.01
February	88	22.78 ±1.85	91.61±22.47	1.00
Pooled Data	252	21.02 ±2.83	73.18±29.53	1.01

The cycles of fish spawning and gonadal development may affect their growth patterns (Gomez, 2020).

The result of the present study is different from the report of Oliveira *et al.* (2015) that the *b* value of *H. affinis* captured from the Northeastern coast of Brazil was 2.208 for males and that for females was 2.985, indicating negative allometric growth. Muhammad (2022) also observed that male and female *H. oxycephalus* exhibited negative allometric growth (b=2.0153) and (2.0468), respectively in Majene waters, West Sulawesi Province. The values of *a* and *b* vary based on sex, stage of development, and eating habits not only between different species but even within the same species (Qasim, 1973 and Bal, 1984).

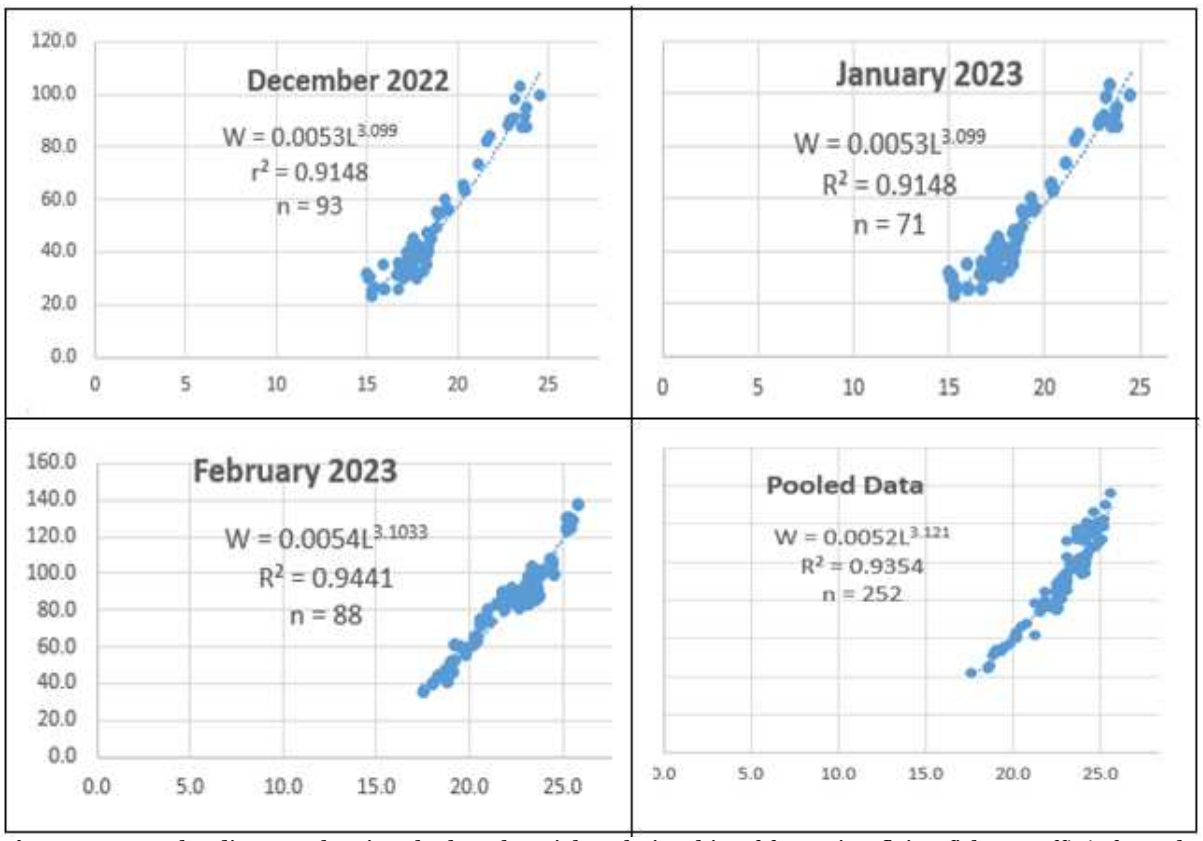

Fig. 2. Scatter plot diagram showing the length-weight relationship of four-wing flying fish, *H. affinis* from the west coast of Surigao del Norte, Philippines.

The correlation coefficients (R^2) were 0.9148, 0.9441, and 0.9354 from December 2022 to February 2023, respectively (Fig. 2 and Table 1). The result suggests that there is a significant relationship and high degree of correlation between the length and weight of the four-wing flying fish. The condition factor of this species sampled from the west coast of Surigao del Norte, Philippines. is ranging from 1.00 to 1.02 (Table 2). It proves that the four-wing flying fish is in a good condition. If the condition factor (K) is greater than 1, the fish is in good condition (Le Cren, 1951), good level of feeding, and has proper environmental conditions (Ujjania *et al.*, 2012). The fish reaches its highest K values when it is fully mature and has a better capacity for reproduction (Angelescu *et al.*, 1958). The gonad development stage (Phan *et al.,* 2021), and food availability (Nasyrah *et al.*, 2021 and Litvinenko *et al.,* 2021) can affect the condition of fish.

Conclusion

The results of the current study show that the growth pattern of four-wing flying fish is slightly increasing from December 2022 to February 2023 and followed a positive allometric growth. The fish exhibited a high degree of correlation between length and weight. The relative condition factor proves that the fish is in a good condition.

Acknowledgment

The authors would like to thank the Surigao del Norte State University (SNSU) – Malimono Campus for allowing us to use the laboratory, tools, and equipment during data analysis. Our sincere thanks also to the faculty and staff, and the Dean of the College of Agri-fisheries and Allied Sciences for their continued support and encouragement in research endeavors.

References

Anderson RO, Gutreuter SJ. 1983. "Length, weight, and associated structural indices", In Nielsen, L., Johnson, D. (Editions) Fisheries Techniques (pp. 284-300. American Fisheries Society, Bethesda, Maryland, 283–300 p.

Angelescu V, Gneri FS, Nani A. 1958. Argentine sea hake (biology and taxonomy) Secr. Marine Service Hydrogenation. Navigation Public, H1004: 1-224.

Bal DV, Rao KV. 1984. Marine fisheries. Tata McGraw-Hill Publishing Company, New Delhi, 1984, 51-73.

Emperua LL, Muallil RN, Donia EA, Pautong AT, Pechon RR, Balonos TA. 2017. Relative abundance of flying fish gillnet fisheries in Maitum, Sarangani province. International Journal of Fisheries and Aquatic Studies. **5(5),** 438-442. Retrieved from http://www.fisheriesjournal.com/archives/2017/vol5issue5/PartF/5-4-68-384.pdf

Garcia CB, Buarte, JO, Sandoval N, Von-Schiller D, Najavas P. 1989. "Length-weight relationships of demersal fishes from the Gulf of Salamanca, Colombia", Fishbyte **21,** 30-32. Retrieved from https://digitalarchive.worldfishcenter.org/handle/20.500.12348/2457

Gayanilo FC, Pauly D. 1997. "FAO ICLARM stock assessment tools (FISAT)", References Manual, FAO Computerized Information Series (Fisheries) **8,** 262.

Gomez BC. 2020. Length-weight relationship of yellow-wing flyingfish, *Cypselurus poecilopterus* (Valenciennes) in the Western Coast of Surigao del Norte, Philippines; IJB, V17, N3, September, P7-12. http://dx.doi.org/10.12692/ijb/17.3.7-12

Gomez BC, Senados TP, Gamboa GZ. 2019. Fishery of flying fish (Exocoetidae) in west coast of Surigao del Norte, Philippines. International Journal of Fisheries and Aquatic Studies **7(5),** 548-554.

Ibrahim AM. 1984. The Nile: Description, hydrology, control, and utilization. Hydrobiologia, **110,** 1-13. https://doi.org:10.1007/BF00025770

Kasimoglu C. 2014. The effect of fish size, age, and condition factor on the contents of seven essential elements in *Anguilla anguilla* from Tersakan Stream Mugla (Turkey). Journal of Pollution Effects and Control 2:2. Retrieved from http://dx.doi.org/10.4172/2375-4397.1000123

Khokiattiwong S, Mahona R, Hunte W. 2000. Seasonal abundance and reproduction of the four-wing flyingfish, *Hirundichthys affinis*, off Barbados. Environmental Biology of Fishes **59,** 43–60 (2000). https://doi.org/10.1023/A:1007647918255

Le Cren ED. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (Perca fluviatilis). Journal of Animal Ecology **20(2),** 201- 219. https://doi.org/10.2307/1540

Litvinenko V, Kotovska G, Buzevitch O, Khrystenko D. 2021. Length-weight relationship and condition factors of white bream, *Blicca bjoerkna* (Linnaeus, 1758) from the Kyiv Reservoir. AACL Bioflux **14(6),** 3283-3290. Retrieved from http://www.bioflux.com.ro/docs/2021.3283-3290.pdf

Mahon R, Oxenford H, Hunte W. 1986. Development strategies for Flying fish fisheries of the eastern Caribbean, International Development Research Centre Man. Rep, 1986, 128e.

Nasyrah AFA, Rahardjo MF, Simanjuntak CPH, Nur M. 2021. The length-weight relationships and condition factor of an endemic Marosatherina ladigesi Ahl, 1936 in Walanae Cenranae River watershed, South Sulawesi, Indonesia. E3S Web of Conferences **322,** 01002. https://doi.org/10.1051/e3sconf/202132201002

Nur M, Ihsan MN, Fitriah R, Nasyrah AFA, Tenriware Jabbar FBA. 2022. Length-weight relationship and condition factor of flying fish Hirundichthys oxycephalus in Majene waters, West Sulawesi Province. AACL Bioflux **15(4),** 2125-2131. Retrieved from 2022.2125-2131.pdf (bioflux.com.ro)

Oliveira MR, Carvalho, MM, Silva NB, Yamamoto ME, Chellappa S. 2015. Reproductive aspects of the flyingfish, Hirundichthys affinis from the Northeastern coastal waters of Brazil. Brazilian Journal of Biology **75(1),** 198-207 p. https://doi.org/10.1590/1519-6984.11513

Phan GH, Linh LTT, Dinh QM, Truong NT, Nguyen THD. 2021. Length-weight relationship, growth pattern and condition factor of *Glossogobius giuris* caught from coastal areas in the Mekong Delta. AACL Bioflux **14(3),** 1478-1485, Retrieved from. www.bioflux.com.ro/docs/2021.1478-1485.pdf

Pauly D. 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Tech. Pap., FAO Rome **234,** 52.

Pauly D. 1984. Fish Population Dynamics in Tropical Waters: A Manual for Use with Programmable Calculators. ICLARM Studies and Reviews **8**, 325p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Petrakis G, Stergiou KI. 1995. Weight-length relationships for 33 fish species in Greek waters. Fisheries Research, **21(3-4),** 465-469. http://dx.doi.org/10.1016/0165-7836(94)00294-7

Qasim SZ. 1973. An appraisal of the studies on maturation and spawning in marine teleosts from the Indian waters. Indian Journal of Fisheries. **20,** 166-181. Retrieved from http://eprints.cmfri.org.in/1230.

Ujjania NC, Kohli MPS, Sharma LL. 2012. Length-weight relationship and condition factors of Indian major carps (*C. catla, L. rohita and C. mrigala*) in Mahi Bajaj Sagar, India. Research Journal of Biology **2(1),** 30-36.

Valset A, Bouchon-Navaro Y, Louis M, Bouchon C. 2007. Weight–length relationships waters. Fish Resources **21,** 465– 469. https://doi.org/10.1111/j.14390426.2007.01023.x