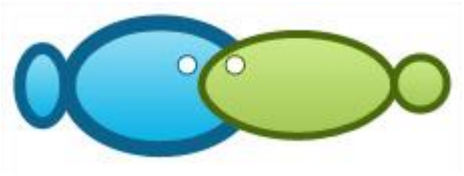

Length-weight relationship and condition factor of silver therapon, *Leiopotherapon plumbeus* (Terapontidae) from two brackishwater habitats

[1]Dionisia A. Santos, [1]Adrian D. C. Manliclic, [1,2]Mark N. C. Corpuz

[1] Institute of Fisheries and Aquatic Sciences, Center for Research on Aquaculture and Aquatic Resources in Brackishwater Systems, Bataan Peninsula State University, Bayan, Bataan, Philippines; [2] School of Environmental Science and Management, University of the Philippines Los Baños, Los Baños, Philippines. Corresponding author: M. N. C. Corpuz, mccorpuz@up.edu.ph

Abstract. This study evaluated the length-weight relationship, ($W = aTL^b$) and condition factor dynamics [$K = W/(aTL^b)$] of endemic silver therapon (*Leiopotherapon plumbeus*, Kner 1864) based on measurements from specimens collected in two brackish water habitats. Fish specimens were collected from fishponds located in Sampalucan, Orani, Bataan (n=500), and in Almacen river (n=380) in Hermosa, Bataan. Length and weight was affected by sex, sites and seasons. The sexual variation in growth rate as inferred by the length-weight relationship was significant, with females being positively allometric (b=3.11), whilst males were negatively allometric (b=2.88). Spatial variation in growth rate was significant between Sampalucan (b=3.07) and Almacen (b=3.02) despite of both being isometric. The growth coefficient in the wet season displayed isometry (b=3.05), whereas in the dry season, it was negatively allometric (b=2.71). The K values were close to the ideal score of 1. The mean condition factor was significantly influenced by sex (1.023±0.015 for females; 0.949±0.006 for males), sampling sites (0.991±0.005 in Sampalucan; 0.983±0.007 in Almacen), and season (1.017±0.008 in the wet season; 0.974±0.014 in the dry season). The mean condition factors in each month were statistically varied, ranging from 0.974 to 1.04.
Key Words: Almacen river, Bataan, endemic, growth rate, isometry, morphometry.

Introduction. Length and weight relationship (LWR) is a reliable tool in fisheries biology to quantitatively estimate standing biomass and yield for fish stock assessment (Das & Bordoloi 2013). Estimation of LWR can provide information on growth parameters in order to shed light on both fish growth rate pattern and their dynamics (Anderson et al 1996; Froese 2006). Likewise, the relative LWR serves as a predictor of fish condition or "wellness", as it is hypothesized that heavier fish of a given length are in better condition (Reist 1985; Jakob et al 1996). Information from these biological parameters also provides insight on how the fish can adapt to a wide spectrum of environmental conditions (Dinh 2017).

The endemic silver therapon (*Leiopotherapon plumbeus*, Kner 1864) is classified in several studies as a freshwater fish species (Herre 1927; Mane 1934), and the only known freshwater terapontid in the Philippines (fishbase.org). It was first described in Laguna de Bay, the largest inland water body in the Philippines, but it has been translocated to various freshwater habitats in Luzon Island, Philippines (Quilang et al 2007; Corpuz et al 2016). It is regarded as an important fishery resource, although its wild population has declined over the past decade (Corpuz 2018). Unknown to many, *L. plumbeus* is also thriving in the brackishwater environment, particularly in estuaries that are draining in Manila Bay (De Leon et al 2017). Moreover, the fish is considered as a by-catch species of shrimp and fish farming, and the larvae are known to enter the brackishwater pond system during pond filling and water exchange.

Several studies have been conducted to evaluate the feeding habits (Añano et al 2015; Aya et al 2015), early development (Aya et al 2017) and aquaculture potential of

this terapontid (PCAARRD 2012; Consigna et al 2019). Zooplankton plays an important role in the nutrition of the fish especially during its early life stages (Aya et al 2015) and environmental conditions, like season, presence of fish pens, etc., could greatly affect its feeding ecology (Kock et al 2008). Despite of such scientific efforts, baseline information on morphometry, LWR, and condition factor (K) of naturally occurring brackishwater populations of *L. plumbeus* have not been studied. To bring new information, the objective of this study was to characterize two populations of *L. plumbeus* based on their morphometry, LWR and condition factor dynamics, with emphasis on spatio-temporal and sexual variability.

Material and Method

Sampling sites and fish collection. Fish specimens were collected from two sites: (1) a fish farm in Orani, Bataan (hereafter denoted as Sampalucan) (14°48' 26" N, 120°32' 40" E), and (2), in the Almacen river system in the northeast of the province (hereafter denoted as Almacen) (14°49'38" N, 120°31'54" E). Specimens were collected during the dry season (February, March, April, and May) and the wet season (July, August, September, and October) in 2017, using fishing gears commonly used by local fishermen (combination of cast nets, seine nets, and gill nets). The studied sites have 2 pronounced seasons: the dry season from November to May, and the wet season during the rest of the year. Fish specimens were sedated and transported to the laboratory for analyses. Details of water quality parameters and habitat variables of each collection site are presented in Table 1.

Table 1

Abiotic and habitat characteristics of the two sampling sites

Abiotic (mean ± SD) and habitat features	*Sampalucan (fishponds) (14°48'26"N, 120°32'40"E)*	*Almacen (wild) (14°49'38"N, 120°31'54"E)*
Water Temperature (°C)	32.01±0.22	29.65±0.41
Salinity (g L^{-1})	22.9±1.65	12.86±3.22
pH	6.54±0.81	6.91±0.89
Secchi disc visibility (cm)	43.37±1.59	30.5±1.12
Substrate and Dominant Vegetation	Clayey+algae, submerged macrophytes	Sandy to clayey loam+perennial riparian macrophytes, mangroves (*Rhyzophora* spp.)

Fish analyses. Prior to analysis, specimens were anesthetized using 2-phenoxyethanol solution (1 mL L^{-1}) to minimize handling stress and possible death. Sex of mature specimens was determined through stripping of milt in males, and collection of oocytes with a catheter in females, while the sex of immature specimens was determined based on their internal genitalia, namely the presence of ovaries for females and testes for males. Gravid specimens were classified as females. In most cases, specimens were kept alive in a holding tank for future studies.

The total length (TL) (from the tip of the snout to the tip of the longest caudal fin ray) was measured using a vernier caliper (to 0.01 mm). Wet weight of fish (W) was determined using a digital balance (g). The allometric relationship between L and W was calculated by the formula of Ricker (1973):

$$W = aTL^b$$

Where: W - weight of an individual (g); TL - total length of an individual (mm); *a* and *b* are constants.

The LW relationships were analyzed by the least square method using the equation of Le Cren (1951):

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

Where *a* and *b* are constants estimated by linear regression of the log-transformed variates. The fish body condition factor was calculated using the function:

$$K = \frac{W}{a\,TL^{b}}$$

Where: W = fish weight (g); TL - total length (mm); *a* - regression intercept; and *b* - regression slope (Le Cren 1951).

Data analyses. Chi-square test was used to determine the extent of deviation of observed females and males ratio to the expected 1:1 ratio ($P<0.05$). The normality of data was subjected to the Shapiro-Wilk test, and was found to be in normal distribution. Variation on morphometric measurements between sexes and between the two sampling sites were compared using t-test, whereas seasonal variation was tested using analysis of variance (ANOVA). Interaction effect of various variables in the changes of TL and W was tested using ANOVA, following a post-hoc test, namely Tukey's test ($P<0.05$).

The analysis of covariance (ANCOVA) was used to test for any difference between regression models that displayed LWR (sex, sites, and seasons). The growth rate (allometric or isometric growth) was tested using the t-test (Aya et al 2017). The value of *b* was tested for theoretical value for isometry, i.e., when b was equal to 3, growth was regarded as isometric ($P<0.05$), when $b<3$, it was negatively allometric ($P<0.05$), and when $b>3$, it was positively allometric ($P<0.05$).

The significance of variability in K between sexes, sites, and seasons was subjected to the Q-test ($P<0.05$); the deviation from the ideal K value of 1 was tested using the t-test ($P<0.05$). The monthly mean value of K, and the effects of sex-season and sex-site interaction on the changes of K were tested using ANOVA ($P<0.05$). SPSS v 16 and SigmaPlot v 11 were used for statistical analyses.

Results and Discussion

Sex ratio and morphometrics. The present study collected a total of 880 specimens (Sampalucan=500, Almacen=380), which were dominated by females (Table 2). Also, females dominated the number of specimens in both seasons (dry=50.55%; wet=56.96%). The overall ratio of 1:1.07 male to female, however, did not statistically deviate from the expected ratio of 1:1 ($\chi^2 = 1.10$; df=1; $P>0.05$).

Mean TL and W of populations from the two sampling sites and seasons are presented in Table 2. The mean TL values of Sampalucan were significantly longer than in Almacen in both seasons (dry: $t=7.43$, $P<0.01$; wet: $t=7.47$; $P<0.01$). Furthermore, *L. plumbeus* specimens collected in the wet season were statistically larger than those collected in the dry season (Sampalucan: $t=30.73$, $P<0.01$; Almacen: $t=9.08$; $P<0.01$). Seasonal variation in TL was highly significant between females ($t=20.31$, $P<0.01$) and males ($t=17.85$, $P<0.01$). Using the pooled data of the two sampling sites, females were slightly longer than males, but no significant sexual variation was observed in either season ($P>0.05$).

Significant variation in mean weight was observed between Sampalucan and Almacen, with the weight of the former being significantly heavier than that of the latter (dry: $t=6.92$, $P<0.01$; wet: $t=8.09$; $P<0.01$). Likewise, specimens collected in the wet season were significantly heavier than those from the dry season (Sampalucan: $t=29.47$, $P<0.01$; Almacen: $t=9.00$; $P<0.01$). Variation in mean weight of female ($t=19.66$, $P<0.01$) and male specimens ($t=16.97$, $P<0.01$) was highly affected by season. No significant variation was observed between the mean weight of the two sexes in the dry season, albeit females were statistically heavier than males in the wet season ($t=3.92$, $P<0.05$).

Table 2

Descriptive statistics and estimated length-weight relationship parameters of *Leiopotherapon plumbeus* during dry and wet seasons

	n	*Length (cm)*	*Weight (g)*	*Regression parameters*		S_b	r^2
		Mean ± SE	*Mean ± SE*	*b*	*a*		
Dry season							
Sampalucan	280	9.11±0.10	12.39±0.34	2.802	0.026	0.087	0.861
Female	145	9.12±0.12	12.59±0.50	2.946	0.019	0.102	0.905
Male	135	9.02±0.11	12.22±0.46	2.571	0.042	0.151	0.787
Almacen	175	8.62±0.04	10.84±0.16	2.638	0.036	0.157	0.808
Female	85	8.67±0.06	11.01±0.24	2.657	0.035	0.209	0.838
Male	90	8.56±0.06	10.66±0.21	2.616	0.038	0.237	0.781
Wet season							
Sampalucan	220	10.57±0.09	20.67±0.53	3.000	0.017	0.098	0.894
Female	114	10.56±0.11	21.08±0.68	3.084	0.018	0.097	0.921
Male	106	10.58±0.15	19.46±0.59	2.502	0.053	0.236	0.695
Almacen	205	9.89±0.09	16.50±0.49	3.018	0.016	0.084	0.921
Female	111	9.98±0.12	17.09±0.63	3.123	0.016	0.136	0.891
Male	94	9.77±0.14	15.68±0.77	3.004	0.015	0.086	0.962

Note: n - number of individuals; SE - standard error; *a* - intercept; *b* - slope; S_b - standard error of slope; r^2 - correlation coefficient.

Growth parameters. The estimated LWR parameters of *L. plumbeus* are summarized in Table 2. Significant variation was observed in the growth rate between populations of dry and wet seasons (ANCOVA F=4.04, P<0.05). Growth rate of *L. plumbeus* in the dry season was negatively allometric (*b*=2.712, P<0.05), whilst the wet season population had an isometric growth rate (*b*=3.052, P<0.05). The spatial variation of the growth coefficient was also significant between Sampalucan and Almacen (ANCOVA F=20.54, P<0.01); the growth rates of the populations from the two sampling sites were isometric (Sampalucan: *b*=3.07, P<0.05; Almacen: *b*=3.02, P<0.05).

Variation in growth parameters between the two populations was significant in the wet season (ANCOVA F=4.35, P<0.05), both showing isometric growth rate. In the dry season, both populations displayed negative allometric growth; no significant variation was observed (ANOVA F=0.04, P>0.05).

Overall, the growth coefficient, as reflected by LWR between sexes, was found to be statistically different (ANCOVA F=8.64, P<0.01), with female growth being positively allometric (*b*=3.11, P<0.05), whilst male growth being negatively allometric (*b*=2.877, P<0.05). Sexual variation in growth parameter was significantly affected by season (ANCOVA F=5.11, P<0.01), and sampling sites (ANCOVA F=20.54, P<0.01).

Condition factor. The monthly variation in the mean condition factor (with a range from 0.974 to 1.04) was statistically significant (ANOVA F=6.22, P<0.05, Figure 1). The parameter K of populations in the wet season (1.017±0.008) was higher than the ideal threshold of 1 and statistically higher than those from the dry season (0.974±0.014) (t=3.69, P<0.05). In combined sexes, no significant difference was observed between populations from Sampalucan (0.991±0.005) and Almacen (0.983±0.007) (t=0.80, P>0.05).

The mean condition factor was affected by sex (t=11.11, P<0.01), with females having a higher value of K. The mean value for the females (1.023±0.015) was not statistically deviated from K=1 (t-test, P>0.05), but the male K value (0.949±0.006) was significantly different from the parameter K=1 (P<0.05). Intersex variation between seasons were observed to be significant (ANOVA F=22.26, P<0.01), albeit seasonal variation of the same sexes was statistically homogeneous (Figure 2). The condition factor was also highly significantly different between sexes from the two sampling sites

(ANOVA F=30.52, P<0.01, Figure 3). In the post-hoc test, the variation in K value of females (1.026±0.006) and males (0.928±0.008) from Sampalucan was significant, albeit sexes from Almacen were not significantly different (female: 0.989±0.01; male: 0.977±0.01).

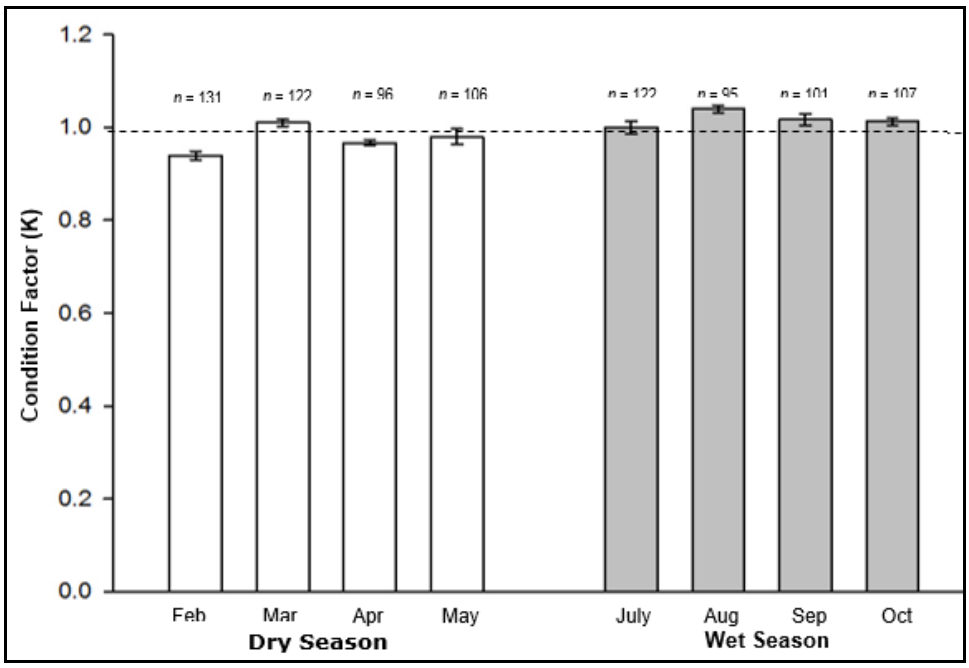

Figure 1. Monthly variation of condition factor (K) of *Leiopotherapon plumbeus*. Dashed line represents the ideal K value. SE is represented by vertical bars. n - number of individuals.

In the present study, morphometric heterogeneity and growth rate (as reflected by LWR) were observed in two populations of *L. plumbeus* thriving in different brackishwater habitats. It has been reported that inter-population variation of morphometric characters in fish is environmentally induced (Corpuz et al 2011). In this study, larger specimens were observed in Sampalucan (fishponds), and this can be attributed to the availability and ease of access to food resources in a semi-controlled habitat. In a pond-based system, exogenous nourishment sources for *L. plumbeus* may be acquired from aquaculture inputs intended for the cultured species (e.g. *Chanos chanos*). Juvenile and adult stages of *L. plumbeus* are reported to accept formulated commercial feeds as their diet in tank-based culture (Consigna et al 2019). Apart from feeds, growth of natural food (mainly zooplankton and phytoplankton) as a result of pond fertilization also brings advantages to the planktivorous feeding habits of *L. plumbeus*. It was documented that *L. plumbeus* consumes a wide variety of food materials including crustaceans (PCAARRD 2012), phytoplankton and zooplankton (Kock et al 2008; Añano et al 2015; Aya et al 2015).

In Almacen, the nourishment of wild *L. plumbeus* is largely dependent on natural food resources. The findings conform to a previous study on *L. plumbeus* populations collected from freshwater and brackishwater environments (De Leon et al 2017). While food availability can be the cause of growth rate differentiation, the result may also have implications on the condition of water quality parameters (Khallaf et al 2003), and other oscillating habitat variables prior to sampling (Froese 2006). Moreover, it was also reported that the physical structure of the habitat can induce a morphological response (Olson & Eklov 2005; Corpuz et al 2013).

It is apparent that seasonal changes affect the dynamics of morphometry, LWR and condition factor of *L. plumbeus*, with better values being observed during wet months. Seasonal factors are known as important variables influencing the fish physiological state (Le Cren 1951), growth rate (Hashim et al 2017), and distribution

(Paller et al 2013). It is logical to mention that various seasonally fluctuating natural factors such as food availability (Tarkan et al 2006), habitat, and reproductive activity (Froese 2006; Miller et al 2015) may have interplayed to cause the observed temporal variability in LWR and condition factor of *L. plumbeus*.

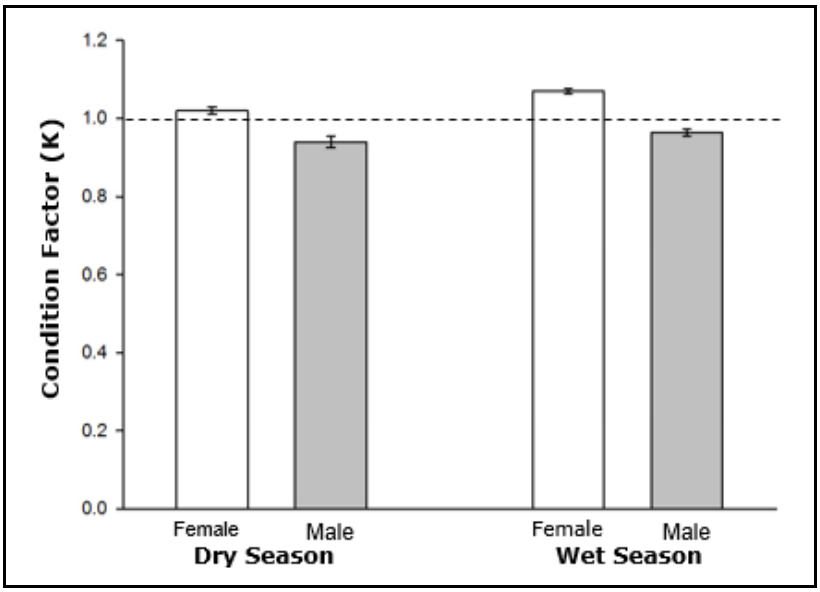

Figure 2. Condition factor (K) between sampling season and sexes of *Leiopotherapon plumbeus*. Dashed line represents ideal K value. SE is represented by vertical bars.

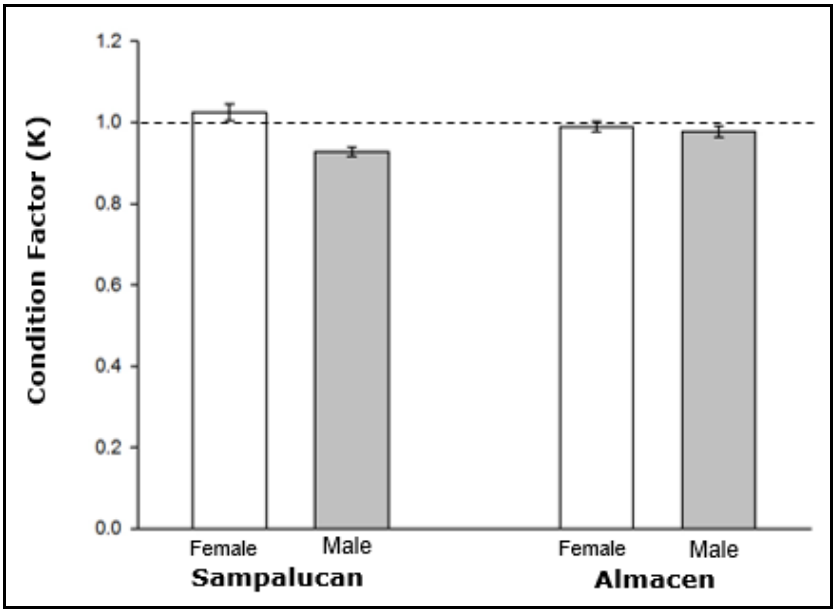

Figure 3. Condition factor (K) between sampling sites and sexes of *Leiopotherapon plumbeus*. Dashed line represents ideal K value. SE is represented by vertical bars.

Specimens collected in the wet season are comparatively larger, exhibited isometric growth rate, and had better condition than those collected in the dry season. These observations could be attributed to the reproductive cycle of the fish, which is similar to what has also been observed by Le Cren (1951). Although *L. plumbeus* has no distinct breeding season (since it breeds throughout the year), higher spawning rates are commonly observed during the onset of the rainy season, in which food items necessary for larval survival are usually abundant (PCAARRD 2012; Denusta et al 2019). However, our findings in LWR and K values did not conform to the seasonal growth rate and K

parameter observed in some species of gobies (Dinh 2017). It is worth to mention that a number of *L. plumbeus* specimens were fecund (examined during sexing of external genitalia), and had rounded and plump appearance, inferring to follicular and spawning oocytes. It was likewise observed that fish collected in all months of the wet season exhibited a K value of more than 1, implying favorable conditions for *L. plumbeus* growth. Further researches are suggested to investigate the correlation of seasonal reproductive status and/or diet shift of the fish with growth coefficients, and condition factor dynamics.

Sexual dimorphism (sites, season, and combined effect) in LWR and condition factor was observed, with females consistently displaying better observations than males. Our study is in accordance to the study of Mallen-Cooper & Stuart (2003), in which females of silver perch (*Bidyanus bidyanus*) are larger than males of the similar age group. Likewise, it was reported that LWR and mean condition factors were higher in females than in males of *Gobius niger* (Kalaycı et al 2007), *Clarias gariepinus* (Ayo-Olalusi 2014), and *Parluciosoma daniconius* (Sanjay et al 2015). Positive allometric growth rate can be associated with the presence of spawning oocytes, which influence the increased weight and bulging of the abdomen in female specimens. While sexual differences were observed, K value remained close to threshold of 1, signifying that both sexes can adapt well in the studied areas, and to the fluctuating environmental conditions brought by seasonal changes. The effect on sexual variation of other variables including body size classes, quantity and quality of food resources, and habitat characteristics are open for future investigations.

Conclusions. The present study revealed that habitat structure, varying seasons, and sex are factors that can influence the significant variation on growth rate, and condition factor of brackishwater *L. plumbeus*. Growth coefficients and fish condition were better in a semi-controlled habitat and during wet months. These observations are also evident in female specimens. The observed morphological variation occurred as a plastic response to varying environmental conditions, pronounced seasonal fluctuations, and its reproductive cycle. The baseline information will be helpful for the assessment of population structure of *L. plumbeus*, which can be essential for the implementation of appropriate ecological and aquaculture management strategies for this Philippine terapontid.

Acknowledgements. The authors are very grateful to the funding from the Research and Development Office of Bataan Peninsula State University (RDO-F062016); to Mr. John Señora, and to the fisherfolks who accommodated the researchers during fish collection; to the fisheries students for their dedication and untiring logistics during fish sampling.

References

Añano J. A., Aya F., Corpuz M. N. C., Romana-Eguia M. R. R., 2015 Optimization of feeding and growth condition for hatchery-bred larvae of indigenous Philippine silver therapon, *Leiopotherapon plumbeus* (Perciformes: Terapontidae). In: Resource enhancement and sustainable aquaculture practices in Southeast Asia: Challenges in responsible production of aquatic species: Proceedings of the international workshop on resource enhancement and sustainable aquaculture practices in Southeast Asia. Romana-Eguia M. R. R., Parado-Estepa F. D., Salayo N. D., Lebata-Ramos M. J. H. (eds), Southeast Asian Fisheries Development Center Aquaculture Department, Tigbauan, Iloilo, Philippines, 327 p.

Anderson R. O., Neumann R. M., Murphy B., Willis D., 1996 Length, weight, and associated structural indices. In: Fisheries techniques. 2nd ed. Murpy B. E., Illis D. W. (eds), American Fisheries Society, pp. 447-481.

Aya F. A., Corpuz M. N. C., Garcia L. M. B., 2015 Diet composition, feed preferences and mouth morphology of early stage silver therapon (*Leiopotherapon plumbeus*, Kner 1864) larvae reared in outdoor tanks. Journal of Applied Ichthyology 31(1):77-82.

Aya F. A., Corpuz M. N. C., Laron M. A., Garcia L. M. B., 2017 Larval and early juvenile development of silver therapon, *Leiopotherapon plumbeus* (Actinopterygii: Perciformes: Terapontidae), reared in mesocosms. Acta Ichthyologica et Piscatoria 47(4):347-356.
Ayo-Olalusi C. I., 2014 Length-weight relationship, condition factor and sex ratio of African mud catfish (*Clarias gariepinus*) reared in flow-through system tanks. Journal of Fisheries and Aquatic Science 9:430-434.
Consigna M. J. S., Corpuz M. N. C., Rabadon M. L. L., Manliclic A. D. C., 2019 Hormone-induced spawning and gonadosomatic index of brackishwater silver therapon (*Leiopotherapon plumbeus*, Kner 1864). Asia Life Sciences 28(2):387-397.
Corpuz M. N. C., 2011 Morphological variations, sexual dimorphism, and gonadal analysis of populations of the Celebes Goby, *Glossogobius celebius* (Perciformes: Gobiidae) from Southern Luzon, Philippines. M.Sc. Thesis, University of the Philippines Los Baños, College, Laguna, Philippines, 123 p.
Corpuz M. N. C., 2018 Diet variation and prey composition of exotic clown featherback, *Chitala ornata* (Gray, 1831) (Osteoglossiformes: Notopteridae) in Laguna de Bay, Luzon Island, Philippines. Asian Fisheries Science 31:252-264.
Corpuz M. N. C., Ocampo P. P., Camacho M. V., 2013 Morphometric and morphomeristic variations of five populations of indigenous Celebes Goby, *Glossogobius celebius* (Perciformes: Gobiidae) from Southern Luzon, Philippines. The Philippine Agricultural Scientist 96(1):75-85.
Corpuz M. N. C., Paller V. G. V., Ocampo P. P., 2016 Diversity and distribution of freshwater fish assemblages in Lake Taal River system in Batangas, Philippines. Journal of Environmental Science and Management 19(1):85-95.
Das M. K., Bordoloi S., 2013 Length-weight relationship and condition factor of *Lepidocephalichthys goalparensis* Pillai and Yazdani, 1976 in Assam, India. Journal of Applied Ichthyology 30(1):246-247.
De Leon K. J. A., Manliclic A. D. C., Corpuz M. N. C., 2017 Spatial and sexual variation on morphometrics, length and weight, and condition factor dynamics of endemic silver therapon (*Leiopotherapon plumbeus*, Kner). International Journal of Agricultural Technology 13(7):1567-1577.
Denusta P. J. T., De Jesus-Ayson E. G., Laron M. A., Aya F. A., Garcia L. M. B., 2019 Gonad development and size-at-maturity of silver therapon *Leiopotherapon plumbeus* (Kner 1864; Teleostei:Terapontidae) in tropical volcanic lakes in south Luzon, Philippines. Journal of Applied Ichthyology 34(4):933-943.
Dinh Q. M., 2017 Morphometrics, and condition factor dynamics of the goby *Stigmatogobius pleurostigma* (Blecker 1949) during dry and wet seasons in the Mekong Delta, Vietnam. Asian Fisheries Science 30:17-25.
Froese R., 2006 Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. Journal of Applied Ichthyology 22(4):241-253.
Hashim M., Abidin D. A. Z., Das S. K., Mazlan A. G., 2017 Length-weight relationship, condition factor and TROPH of *Scatophagus argus* in Malaysian coastal waters. AACL Bioflux 10(2):297-307.
Herre A. H., 1927 Gobies of the Philippines and the China Sea. Monograph of the Bureau of Science. Bureau of Printing, Manila, 352 p.
Jakob E. M., Marshall S. D., Uetz G. W., 1996 Estimating fitness: a comparison of body condition indices. Oikos 77(1):61-67.
Kalaycı F., Samsun N., Bilgin S., Samsun O., 2007 Length-weight relationship of 10 fish species caught by bottom trawl and midwater trawl from the Middle Black Sea, Turkey. Turkish Journal of Fisheries and Aquatic Science 7:33-36.
Khallaf E. A., Galal M., Authman M., 2003 The biology of *Oreochromis niloticus* in a polluted canal. Ecotoxicology 12:405-416.
Kock M., Focken U., Richter H., Becker K., Santiago C. B., 2008 Feeding ecology of silverperch, *Terapon plumbeus* Kner, and the impact of fish-pens in Laguna de Bay, Philippines. Journal of Applied Ichthyology 16(6):240-246.

Le Cren E. D., 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.
Mallen-Cooper M., Stuart I. G., 2003 Age, growth and non-flood recruitment of two potamodromous fishes in a large semi-arid/temperate river system. River Research and Application 19(7):697-719.
Mane A. M., 1934 Spawning and feeding habits of *Mesopristes plumbea* (Kner), a common therapontid of Laguna de Bay. Philippine Agriculturist 6(23):502-515.
Miller S. J., VanGenechten D. T., Cichra C. E., 2015 Length–weight relationships and an evaluation of fish–size and seasonal effects on relative condition (K_n) of fishes from the Wekiva River, Florida. Florida Scientist 78(1):1-19.
Olson J., Eklov P., 2005 Habitat structure, feeding mode and morphological reversibility: factors influencing phenotypic plasticity in perch. Evolutionary Ecology Research 7(8):1109-1123.
Paller V. G. V., Corpuz M. N. C., Ocampo P. P., 2013 Diversity and distribution of freshwater fish assemblages in Tayabas River, Quezon (Philippines). Philippine Journal of Science 142(1):55-67.
Quilang J. P., Basiao Z. U., Pagulayan R. C., Roderos R. R., Barrios E. B., 2007 Meristic and morphometric variation in the silver perch, *Leiopotherapon plumbeus* (Kner, 1864), from three lakes in the Philippines. Journal of Applied Ichthyology 23(5):561-567.
Reist J. D., 1985 An empirical evaluation of several univariate methods that adjust for size variation in morphometric data. Canadian Journal of Zoology 63(6):1429-1439.
Ricker W. E., 1973 Linear regressions in fishery research. Journal of Fisheries Research Board of Canada 30:409-434.
Sanjay D., Abujam S., Mofidul I., Nilam B., 2015 Length-weight relationship and condition factor of *Parluciosoma daniconius* (Hamilton) from the upper Assam, India. Journal of Fisheries Science.com 10(1):53-56.
Tarkan A. S., Gaygusuz Ö., Acipinar H., Gürsoy C., Özulug M., 2006 Length–weight relationship of fishes from the Marmara region (NW-Turkey). Journal of Applied Ichthyology 22(4):271-273.
***http://www.fishbase.org
***PCAARRD (Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development), 2012 Induced spawning and larval rearing of ayungin (*Leiopotherapon plumbeus* Kner). Information Bulletin No. 20. Los Baños, Laguna, 23 p.

Received: 06 July 2019. Accepted: 31 October 2019. Published online: 14 June 2020.
Authors:
Dionisa Andaya Santos, Institute of Fisheries and Aquatic Sciences, Center for Research on Aquaculture and Aquatic Resources in Brackishwater Systems, Bataan Peninsula State University, 2112 Bayan, Orani, Bataan, Philippines, e-mail: santosnisia24@gmail.com
Adrian Deil Castro Manliclic, Institute of Fisheries and Aquatic Sciences, Center for Research on Aquaculture and Aquatic Resources in Brackishwater Systems, Bataan Peninsula State University, 2112 Bayan, Orani, Bataan, Philippines, e-mail: deilmanliclic@gmail.com
Mark Nell Castillo Corpuz, Institute of Fisheries and Aquatic Sciences, Center for Research on Aquaculture and Aquatic Resources in Brackishwater Systems, Bataan Peninsula State University, 2112 Bayan, Orani, Bataan, Philippines; School of Environmental Science and Management, 4030 University of the Philippines Los Baños, College, Los Baños, Laguna, Philippines, e-mail: marknellcorpuz@yahoo.com; mccorpuz@up.edu.ph
This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.
How to cite this article:
Santos D. A., Manliclic A. D. C., Corpuz M. N. C., 2020 Length-weight relationship and condition factor of silver therapon, *Leiopotherapon plumbeus* (Terapontidae) from two brackishwater habitats. AACL Bioflux 13(3):1495-1503.