Albanian j. agric. sci. 2015;14 (1): 47-53 *Agricultural University of Tirana*

RESEARCH ARTICLE **(Open Access)**

Growth Indicators of *Engraulis encrasicolus*, (Linnaeus, 1758) Populations in Albanian Waters for Two Seasons of their Lifecycle

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Abstract

Morphometric studies are essential to determine the growth form and growth rate of a species, which is important for responsible exploitation and management of the population of a species. The length-weight relationship was computed for the anchovy *Engraulis encrasicolus*, (Linnaeus, 1758). A total of 656 individuals were used for the study. The length and weight measurements of the fish are positively related to each other. From the study result that the average values according to seasons of coefficient "b" are 3.0259 ± 0.1633 for the period from January to February and 2.8585 ± 0.1788 for period October - November. Condition factor for the same period respectively have values Kn = 0.60 ± 0.23 (January 0.45 ± 0.04 and February 0.72 ± 0.22) and Kn = 0.90 ± 0.42 for period October – November. The study indicates inter-seasonal variation by change of weight in relation to length of fish. The higher Kn value (Kn = 1.19) is indicative of increased deposition of fat as a result of adaptability and high feeding activity, corresponding with the end of the spawning season.The weight-length relationship is a useful tool in fish biology, physiology, ecology and stock assessment. In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent. Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics [7]

Keywords: Anchovy, allometry, growth indicators, small pelagic fish.

1. Introduction

Anchovy, *Engraulis encrasicolus* (Linnaeus, 1758) is an endemic species of the Atlantic – Mediterranean region and is the only representative of the Engraulidae family. It occurs in the Mediterranean, Black Sea, North Africa, and Atlantic coasts northwards to southern North Sea and coasts of the British Isles and Azov Sea. The small pelagic fisheries are very important in the Adriatic fishery (in particular, anchovy and sardine) both for economic reasons (total value of catches) and for social reasons (number of fishermen involved) [12].

The study of length-weight relationship in fish helps to determine the mathematical correlation between two variables and to calculate the variation from the expected weight for length of the individuals of the fishes [16]. Length-weight relationships (LWRs) are also useful in fishery management for both in applied and basic use to estimate weight from length observations, calculate production and biomass of a fish population and/or provide information on stocks or organism condition at the corporal level [9]. The length-weight relationship helps to evaluate the condition, reproduction, life cycle & general health of the fish species. The ratio of length to weight of fish is known to be a useful index of the condition of the fish and plays a significant role in fishery in monitoring sustainable yield. The relationship studies give important information in fishery assessment for predicting weight from length required yield assessment. The measurement of growth as length and weight are highly correlative. The length-weight relationship is an important tool in fish biology, physiology, ecology and fisheries assessment.

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(Accepted for publication March 25, 2015)
***ISSN**: 2218-2020, © Agricultural University of Tirana*

The condition factor is used to compare the condition, fatness or wellbeing of the fish and is based on the hypothesis that heavier fish of a given length is better condition [2]. Fulton's condition factor, Kn [6] will help determine present and future population success by its influence on growth, reproduction and survival [9]. The length-weight parameters of same species may be different in the population because of feeding, reproduction activities, fishing, etc., which can be frequently used in the analysis of ontogenic changes. Furthermore, LWRs allow life history and morphological comparisons between different fish species or between fish populations from different habitats and/or regions. Therefore, we need to know length-weight relationship of fish that are captured in the given place in a certain period. The study conducted for this purpose established length-weight relationship of anchovy *Engraulis encrasicolus*, (Linnaeus, 1758) from the Albanian waters of Adriatic Sea.

2. Materials and Methods

The random sample of fish *Engraulis encrasicolus*, (Linnaeus, 1758) were obtained from Shengjin fishing Port from fishing vessels Rozafa 13 and 14 that use mid-water pair trawling fishing method and Mare Adriatik fishing vessel that uses purse seine with light attraction fishing method. Fish from vessels are taken during the landing process. Data was collected from October 2013 to February 2015. A total of 656 specimens were analyzed for the biometric parameters. Total length was measured using fish measuring board to the nearest millimeter and weight was measured by electronic balance (fig 1). The LWR was subsequently determined using the equation $W = aL^b$ given by Le Cren (1951) [13] and logarithmically transformed into $\log W = \log a + b \log L$ where W is the weight of the fish in gram and L is the total length of the fish measured in millimeter.

Figure 1. Fish measuring and weighing

3. Results and Discussion

The length-weight relationship for *Engraulis encrasicolus*, (Linnaeus, 1758) ranging in size from 90 mm to 160 mm was estimated during the period of eleven months from October 2013 to February 2015.

The weight (W) of fishes (and other organisms) is exponentially related to their length (L) according to the equation $W = aL^b$, where "a" is the intercept (initial growth coefficient) and "b" is the slope (growthcoefficient)of the log-transformed relation [3, 6, 7]. The theoretical value of "b" in length-weight relationship is reported as 3 (Cube's law), when body form of fish remains constant at different lengths, i.e. the growth in fish is isometric, dimensions increase at the same rate, hypoallometric ($b < 3$, a fish increases less in weight than predicted by its increase in length, i.e., it becomes more elongated as it grows; also termed negative allometric) or hyperallometric ($b > 3$, a fish increases more in weight than predicted by its increase in length, i.e., it becomes less elongated or more roundish as it grows; also termed positive allometric). Weight–length relations (WLRs) can be used for converting lengths into biomass, determining fish condition, comparing fish growth among areas, and as a complement to species-specific reproduction and feeding studies [10]. Thus, they are an important component of fisheries biology and when properly calculated they can be very useful to fisheries management.

The condition factor is used to compare the condition, fatness or well being of the fish and is based on the hypothesis that heavier fish of a given length is better condition [2]. Condition factor will help determine present and future population success by its influence on growth, reproduction and survival [9]. Generally, "b" isassumed to be 3 for calculating the condition factor.Therefore, it was thought convenient to use calculated "b" values instead of the constant 3 for condition factorcalculations, as explained by [1].

The results of processing data are shown in figures 2- 8 and summarized in Table 1. Table 1 is prepared according the procedures suggested by [5]. The length and weight measurements of the fish are positively related to each other. According to the [8] if the value of "r" is found to be higher than 0.5 the length-weight relationship is positively correlated.

From the table 1 result that the average values according to seasons of coefficient "b" are 3.0259 ± 0.1633 for the period from January to February and 2.8585 ± 0.1788 for period October - November. Condition factor for the same period respectively have values Kn = 0.60 ± 0.23 (January 0.45 ± 0.04 and February 0.72 ± 0.22) and Kn = 0.90 ± 0.42 for period October – November.

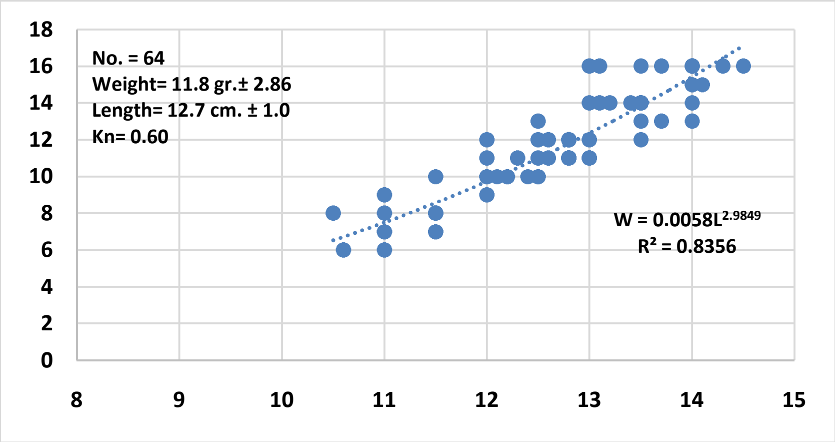

Figure 2. Weight Length Relationship 15 October 2013

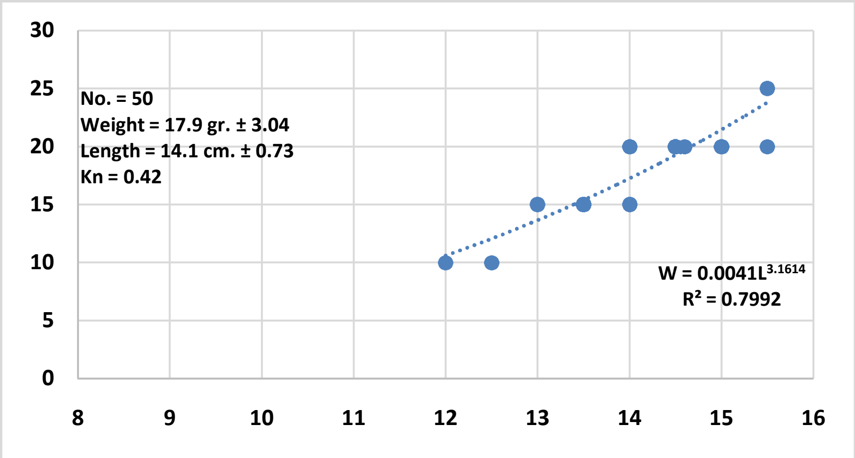

Figure 3. Weight Length Relationship 17 January 2014

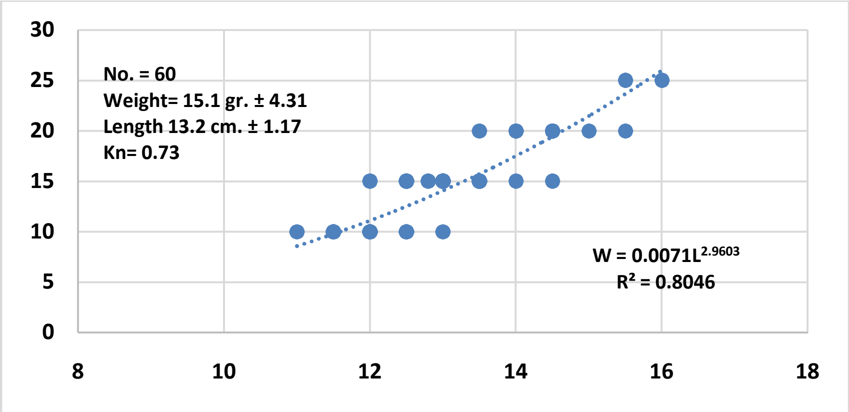

Figure 4. Weight Length Relationship 22 February 2014

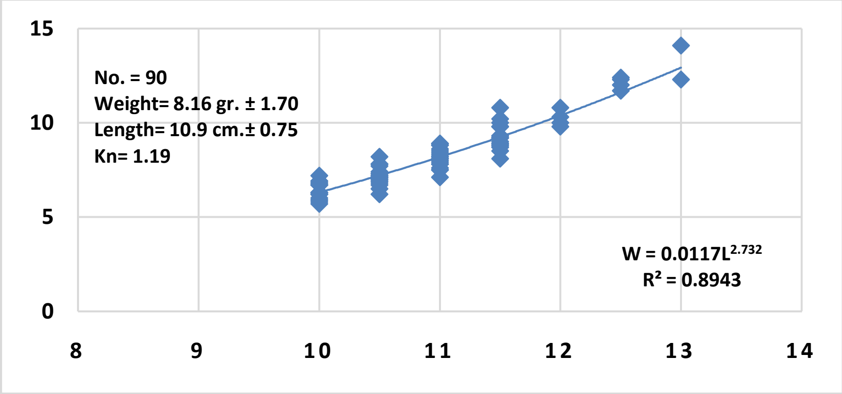

Figure 5. Weight Length Relationship 4 November 2014

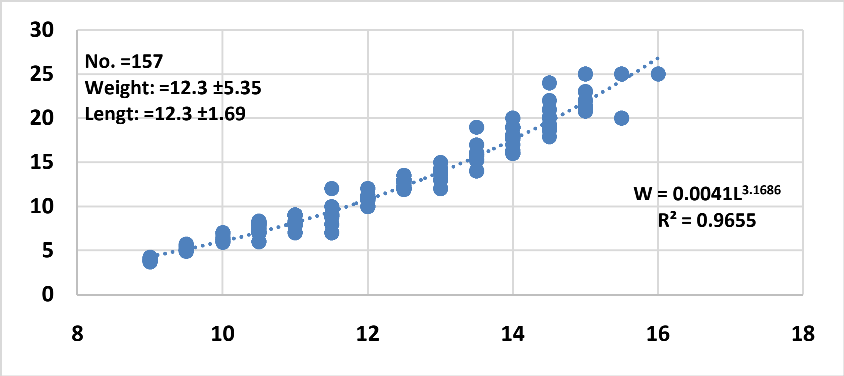

Figure 6. Weight Length Relationship 14 January 2014

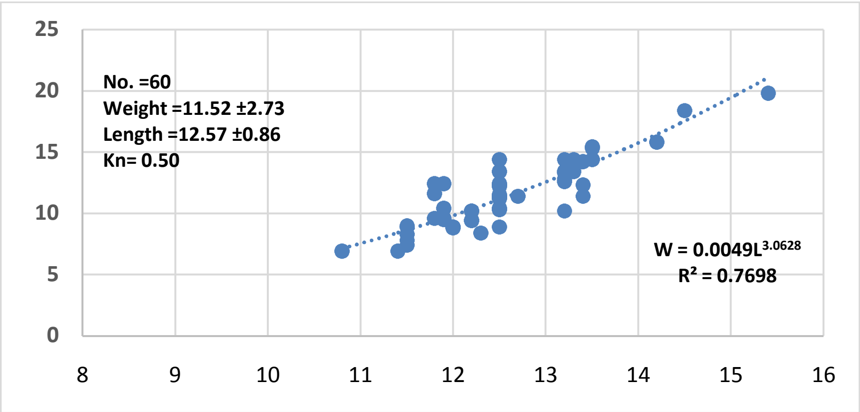

Figure 7. Weight Length Relationship 22 January 2015

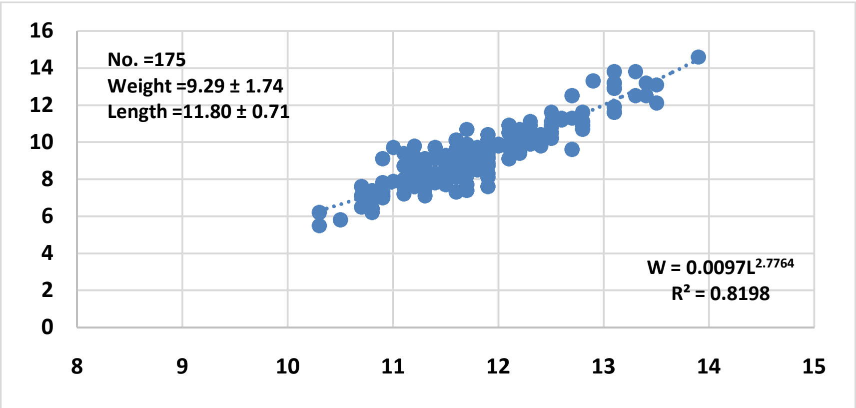

Figure 8. Weight Length Relationship 15 February 2015

The study indicates inter-seasonal variation by change of weight in relation to length of fish. The higher Kn value (Kn=1.19) is indicative of increased deposition of fat as a result of adaptability and high feeding activity, corresponding with the end of the spawning season. Based on [11], the pattern of energy allocation to reproduction in anchovies and sardines seems to be largely dependent on the temporal lag between the feeding and the spawning seasons. As a corollary, different populations deploy a variety of patterns that may range from “capital” to “income” breeding. As a rule of thumb, engraulid species that reproduce during the warm months of the year, seem to rely heavily on current food intake for egg production, i.e., these species exhibit a reproductive strategy which is more close to that of income breeders. Several studies shown that most spawning energy derives from daily feeding, not fat reserves. Somatic growth increases significantly during the spawning season, so feeding not only meets energy requirements for daily spawning but also provides surplus energy for growth. Similar energy allocation patterns seem to characterize different stocks of the summer spawning European anchovy[11]. This data confirm that we have an increase of deposition of fat at the end of spawning season.

Whereas lower Kn value (Kn=0.42 and 0.44, 0.50) are connected with the same period of the year (January 2014 and 2015).

Table 1. Summarized of parameters from data processing

Date	No. Individ.	W_{mean}	L_{mean}	a	b	Kn	R^2	r
15.10.2013	64	11.80 ± 2.86	12.70 ± 1.00	0.0058	2.98	0.60	0.84	0.91
17.01.2014	50	17.61 ± 3.05	13.85 ± 0.73	0.0041	3.16	0.42	0.80	0.89
22.02.2014	60	15.17 ± 4.31	13.21 ± 1.17	0.0071	2.96	0.73	0.80	0.89
04.11.2014	90	8.16 ± 1.70	10.93 ± 0.75	0.0117	2.73	1.19	0.89	0.94
14.01.2015	157	12.43 ± 5.35	12.29 ± 1.69	0.0041	3.17	0.44	0.97	0.98
22.01.2015	60	11.53 ± 2.73	12.57 ± 0.86	0.0049	3.06	0.50	0.77	0.88
15.02.2015	175	9.29 ± 1.74	11.80 ± 0.72	0.0097	2.78	0.94	0.82	0.91

Contradictions that can be observed between values of“b” and Condition factor Kn can be explained by the fact that “b” shows more the level of meeting the needs of the environment among Condition factor Kn shows how physiological condition (physiological status) responds to the exploitation of resources in the environment.

The study is based on data of landings and the results are related to the seasons of fishing activity of small pelagic in Albania. It would be interesting in the future, that in addition to data from industrial fisheries, to evaluate the above parameters also during the other months of the year, when in Albania this activity is not conducted.

4. Conclusions

In this study were evaluated some analytical growth indicators of anchovies population *Engraulis encrasicolus*, (Linnaeus, 1758) in South Adriatic, Albanian part. From the study results that the average values according to seasons of coefficient "b" are 3.0259 ± 0.1633 for the period from January to February and 2.8585 ± 0.1788 for period October - November.Condition factor for the same period respectively have values Kn = 0.60± 0.23 (January 0.45 ± 0.04 and February 0.72 ± 0.22) and Kn = 0.90 ± 0.42 for period October - November.

5. Acknowledgments

The authors appreciate the support given by Rozafa Company and in particular, the crew of Rozafa 13 fishing vessel that helped authors during sea expeditionsand in the creation of all the conditions for data collection used in this study.

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