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Importance Of Length-Length And Length-Weight Relations In Crayfish

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Abstract: The measurement of individual's body weight and length is a fundamental procedure in the scientific study of a species. Regression equations of the relationships between length-length and length-weight in crayfish are used to compare populations in terms of condition, growth and development, sexual maturity and populations in different regions. On the other hand, the most important factors affecting the meat yield in freshwater crayfish include ecological characteristics, genetic structure and catching time. In addition, in the determination of meat yield content, the relations between length-length and length-weight are commonly used. In this study, the importance of length-length and length-weight relationships in freshwater crayfish is explained in detail.

Key words: Decapod, population, carapace, abdomen, cheliped, claw.

Kerevitlerde Uzunluk-Uzunluk ve Uzunluk-Ağırlık İlişkilerinin Önemi

Özet: Bireylerin vücut uzunluğu ve ağırlığının ölçülmesi, bir türün bilimsel çalışmasında temel bir prosedürdür. Kerevitlerde uzunluk-uzunluk ve uzunluk-ağırlık arasındaki ilişkilerin regresyon denklemleri populasyonların kondüsyon, büyüme ve gelişme, eşeysel olgunluk ve farklı bölgelerdeki populasyonlarının karşılaştırılmasında kullanılmaktadır. Bununla birlikte, tatlısu istakozlarında uzunluk-uzunluk ve uzunluk-ağırlık arasındaki ilişkilerin özellikle ekonomik olarak işletilen populasyonlar açısından da bilinmesi gereklidir. Öte yandan, tatlısu istakozlarında et verimini etkileyen en önemli faktörler arasında, ortamın ekolojik özellikleri, genetik yapı ve avlanma zamanı bulunmaktadır. Et veriminin belirlenmesinde ise uzunluk-uzunluk ve uzunluk-ağırlık arasındaki ilişkilerden yaygın olarak yararlanılmaktadır. Bu çalışmada tatlısu istakozlarında uzunluk-uzunluk ve uzunluk-ağırlık ilişkilerinin önemi detaylı olarak açıklanmıştır.

Anahtar kelimeler: Dekapod, populasyon, karapaks, abdomen, kiliped kısaç.

1. Introduction

Crayfish are accepted as keystone species in many lake and streams and they dominate the benthic biomass in many cases. There are more than 600 different crayfish species present worldwide, and they are found in all continents but not in Antarctica [1]. However, approximately 15 freshwater crayfish have been accepted as economically important especially for the last 30 years not only because of their ecological importance due to their spread over such a wide area in the natural environment but also because of the following reasons:

- Use of crayfish shell in pharmacy and medicine as raw materials (i.e., chitin and chitosan production) [2-4],
- They are consumed as a luxury feedstuff [5-8],
- Wastes of crayfish processing units (i.e., viscera, muscle and shell) are used as feed additives and fertilizers [9-13],
- Indirect use of crayfish (i.e., keeping crayfish in aquariums as a hobby, recreational, cultural, ethical, aesthetic, scientific and education values) [14, 15].

2. Importance of Length-Length and Length-Weight Relations in Freshwater Crayfish

The crayfish need moult to grow to size. Therefore, the age of the crayfish cannot be determined due to the change of shells. As a result; length-length and length-weight relationships are commonly considered in crayfish instead of age determination. In addition, length-length and length-weight relationships are considered important parameters to obtain information about the following characteristics of crayfish:

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- Comparison of males and females [16-24],
- Estimation of egg size and egg number with growth rate and size in sexual maturity [25- 27],
- Comparison of different species [28-34],
- Comparison of different populations of same species [35-39],
- Determination of condition factor [39-43].

2.1 Determination of length – length relationships

Following body lengths are used to determine length-length relationships in crayfish [16, 33, 38]:

Carapace length (CL),
Carapace width (CW),
Abdomen length (AL),
Abdomen width (AW),
Total length (TL)
Chelae length (ChL),
Chelae width (ChW);
Cheliped length (ChpL)

Figure 1 shows the locations where the measurements of these length patents are taken in crayfish.

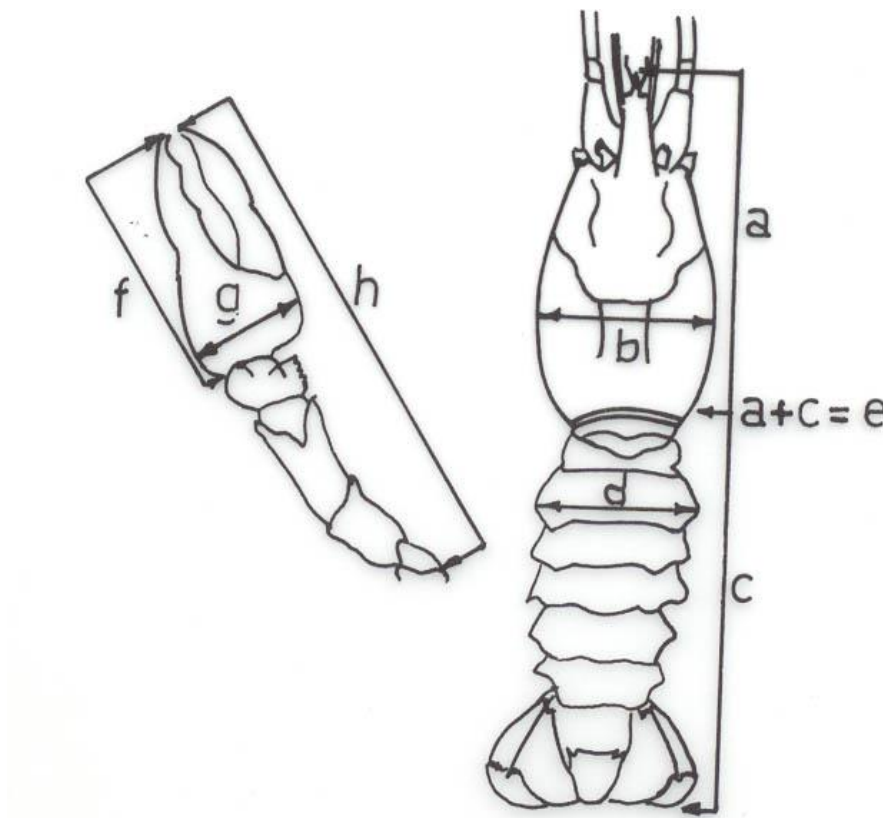


Figure 1. A diagram of freshwater crayfish showing the length measurements taken (adapted from Rhodes and Holdich, 1979) (Legend: (a): CL, from tip of the rostrum to the posteriomedial edge of the carapace, (b): CW, at the widest point of the thorax, (c): AL, from posteriomedial edge of the carapace to the tip of telson (excluding setae), (d): AW, at the widest point of the second segment, (e): TL, from the tip of rostrum to the tip of telson (excluding setae) (carapace length + abdomen length), (f): ChL, from carpal joint to the tip of the propodus, (g): ChW, at the widest point of chelae, (h): ChpL from the tip of propodus to basapodite

On the other hand, the relationship between length parameters is examined in the form below formula:

$$\log y = \log (a) + b \log (x) \quad (1)$$

The linearity of the relationship between the "r" value parameters obtained as a result of the regression analysis; The relationship is isometric when the constant "b" is "3", a negative relationship if "less than 3" and a positive allometric relationship if "greater than 3" [28, 31, 32].

2.2 Determination of length - weight relationships in freshwater crayfish

Carapace length – body weight and abdomen length – body weight relationships are commonly considered to evaluate length - weight relationships in freshwater crayfish. The relationships between length - weight are examined in the form below formula [24, 34, 36, 42, 43]:

$$W = aL^b$$

W = Body Weight (g)
L = Carapace Length or Carapace Width (mm)

3. Determination of Condition Factor (CF) in Freshwater Crayfish

The condition factor is a parameter that expresses the quantitative effect on the condition of the feed or the feeding method applied [44].

Following formula is used to calculate the nutritional capacity and the conditioning factor that gives information about the nutritional level in crayfish [39-41]:

$$CF = [\text{Body Weight (g)} / (\text{Carapace Length (cm)})^3] \times 100 \quad (2)$$

4. Conclusion

It can be concluded that providing information on the length-length and length-weight relations in crayfish is a crucial procedure in the scientific study of a species (i.e., showing differences between crayfish populations, determining relative growth, comparing populations of the same species, use of morphological characteristics in the systematic classification of crayfish). The most commonly considered body lengths for crayfish are carapace length, total body (carapace+abdomen) length, and body wet weight. Length-length and length-weight relations are also important when crayfish are subjected to commercial use. In addition, it can be concluded that length-weight relationship of a crayfish species is used to calculate the standing stock biomass. Therefore, understanding the relationship between length-length and length-weight can have significant implications for the culture and management of aquaculture species.

References

- [1] Holdich, D.M. Biology of freshwater crayfish. MPG Books Ltd, Bodmin, Cornwall, Great Britain, 2002.
- [2] Bautista, J, Jover, M., Gutierrez, J.F., Corpas, R., Cremades, O., Fontiveros, E., Iglesias, F. and Vega, J. Preparation of crayfish chitin by in situ lactic acid production. *Process Biochemistry* 2001; 37: 229–234.
- [3] Inoue, H., Ozaki, N. and Nagasawa, H. Purification and structural determination of a phosphorylated peptide with anti-calcification and chitin-binding activities in the exoskeleton of the crayfish, *Procambarus clarkii*. *Biosci. Biotechnol. Biochem.* 2001; 65(8): 1840-1848.
- [4] Kumar, R.S. Physicochemical, functional and spectroscopic analysis of crawfish chitin and chitosan as affected by process modification. LSU Historical Dissertations and Theses, 2001. https://digitalcommons.lsu.edu/gradschool_disstheses/432
- [5] Lindqvist, O.V., Louekari, K. Muscle and hepatopancreas weight in *Astacus astacus* L. (Crustacea, Astacidae) in the trapping season in Finland. *Annales of Zoology Fennici* 1975; 12: 237-243.
- [6] Huner J.V., Lindqvist O.V. and Könönen, H. Sexual dimorphism and yield of edible products from a stunted, by commercial standards, population of noble crayfish (*Astacus astacus* L) in central Finland. *Freshwater Crayfish* 1995; 8: 668-679.

- [7] Harlioğlu, M.M., Holdich, D.M. Meat yields in the introduced crayfish, *Pacifastacus leniusculus* and *Astacus leptodactylus*, from British waters. *Aquaculture Research*, 2001; 32: 411-417.
- [8] Harlioğlu, M.M., Köprücü, K., Harlioğlu, A.G., Yılmaz, Ö., Mişe Yonar, S., Aydın, S. and Çakmak Duran, T. Effects of dietary n-3 polyunsaturated fatty acids on the nutritional quality of abdomen meat and hepatopancreas in a freshwater crayfish (*Astacus leptodactylus*). *Journal of Food Composition and Analysis* 2015; 41: 144–150.
- [9] Lovell, R.T., Lafleur, J.R. and Hoskins, F.H. Nutritional value of freshwater crayfish waste meal. *J. Agric. Food Chem.*, 1968;16 (2): 204–207.
- [10] Chen, H., Meyers, S.P. Extraction of astaxanthin pigment from crawfish waste using a soy oil process. *Journal of Food Science*1982; 47:892-896.
- [11] Bilgin Ş., Ufuk Z. and Fidanbaş, C. Nutritional Properties of Crab (*Potamon potamios* Olivier, 1804) in the Lake of Eğirdir (Turkey). *Pak Vet J*, 2011; 31(3): 239-243.
- [12] Asafa, A.R. Ologhobo, A.D. and Adejumo, I.O. Effect of crayfish waste meal on performance characteristics and nutrient retention of broiler finishers. *International Journal of Poultry Science*, 2012;11(8): 496-499.
- [13] Küçükgülmez, A. Extraction of Chitin from Crayfish (*Astacus leptodactylus*) Shell Waste. *Alinteri Journal of Agriculture Sciences*, 2018; 33(1): 99-104.
- [14] Gherardi, F. Towards a sustainable human use of freshwater crayfish (Crustacea, Decapoda, Astacidea). *Knowledge and Management of Aquatic Ecosystems* 2011; 401, 02, 22p.
- [15] Turkmen, G., Karadal, O. The survey of the imported freshwater decapod species via the ornamental aquarium trade in Turkey. *Journal of Animal and Veterinary Advances*, 2012; 11(15): 2824-2827.
- [16] Rhodes, C.P., Holdich, D.M. On size and sexual dimorphism in *Austropotamobius pallipes* (Lereboullet). A step in assessing the commercial exploitation potential of the native British freshwater crayfish. *Aquaculture* 1979; 17: 345-358.
- [17] Rhodes, C.P., Holdich, D.M. Length-weight relationship, muscle production and proximate composition of the freshwater crayfish *Austropotamobius pallipes* (Lereboullet). *Aquaculture* 1984; 37: 107-123.
- [18] Garvey, J.E., Stein, R.A. Evaluating how chela size influences the invasion potential of an introduced crayfish (*Orconectes rusticus*). *American Midland Naturalist*, 1993; 129: 172–181.
- [19] Gu H., Mather P.B. and Capra M.F. The relative growth of chelipeds and abdomen and muscle production in male and female redclaw crayfish, *Cherax quadricarinatus* von Martens. *Aquaculture* 1994; 123: 249-257.
- [20] Harlioğlu, M.M. Comparative biology of the signal crayfish, *Pacifastacus leniusculus* (Dana), and the narrow clawed crayfish, *Astacus leptodactylus* Eschscholtz. PhD Thesis, University of Nottingham, UK. 1996.
- [21] Fidalgo, M.L. Carvalho, A.P. and Santos, P. Population dynamics of the red swamp crayfish, *Procambarus clarkii* (Girard, 1852) from the Aveiro region, Portugal (Decapoda, Cambaridae). *Crustaceana*, Leiden, 2001;74 (4): 369-375.
- [22] Huner, J.V. *Procambarus*. In: D.M. Holdich (ed), *Biology of Freshwater Crayfish*. Blackwell Science, Oxford, 2002 pp. 541-574.
- [23] Harlioğlu, M.M., Güner, U. Studies on the recently discovered crayfish, *Austropotamobius torrentium* (Shrank, 1803), in Turkey: morphological analysis and meat yield. *Aquaculture Research* 2006; 37: 538-542.
- [24] Mohsenpour, Azari, A., Harlioğlu, MM., Feridon M. and Masoud, S. Sex ratio, length and weight frequency of freshwater crayfish (*Astacus leptodactylus*) inhabiting in Aras dam lake, Iran. *Istanbul University Journal of Fisheries & Aquatic Sciences*, 2014; 29(2): 33-44.
- [25] Harlioğlu, M.M., Türkgülü, İ. The relationship between egg size and female size in freshwater crayfish, *Astacus leptodactylus*. *Aquaculture International*, 2000; 8:95-98.
- [26] Harlioğlu, M.M., Barım, Ö., The effect of dietary vitamin E on the pleopodal egg and stage-1 juvenile numbers of freshwater crayfish *Astacus leptodactylus* (Eschscholtz, 1823). *Aquaculture*, 2004; 236: 267-276.
- [27] Harlioğlu, M.M., Çakmak, M.N., Köprücü, K., Aksu, Ö., Harlioğlu, A.G., Mişe Yonar, S., Çakmak Duran, T., Özcan, S. and Gündoğdu, H. The effect of dietary n-3 series fatty acids on the number of pleopadal egg and stage 1 juvenile in freshwater crayfish, *Astacus leptodactylus* Eschscholtz. *Aquaculture Research*, 2013; 44: 860-868.
- [28] Romaine, R.P., Forester J.S. and Avault J.W., Jr. (1977). Length-weight relationships of two commercially important crayfishes of the genus *Procambarus*. *Freshwater Crayfish* 3, 463-470.
- [29] Huner, J.V., Lindqvist, O.V. and Könönen, H. Comparison of morphology and edible tissues of two important commercial crayfishes, the noble crayfish, *Astacus astacus* Linné, and the red swamp crayfish, *Procambarus clarkii* (Girard) (Decapoda, Astacidae and Cambaridae). *Aquaculture*, 1988; 68: 45–57.
- [30] Huner J.V. Recovery of edible products from some common North American Orconectid and Procambarid crayfish (Cambaridae) with emphasis on *Procambarus clarkii* (Girard) and *Procambarus zonagulus* Hobbs & Hobbs. *Freshwater Crayfish* 1993; 9: 28-37.
- [31] Mackeviciene, Ç.G. A comparative study of physiological and biochemical indices of native European and alien species of crayfish in Lithuania. *Freshwater Crayfish* 1999; 12: 205-220.
- [32] Harlioğlu, M.M. A comparison of the growth and survival of two freshwater crayfish species, *Astacus leptodactylus* Eschscholtz and *Pacifastacus leniusculus* (Dana) under different temperature and density regimes. *Aquaculture International* 2009; 17: 31-43.
- [33] Harlioğlu, M.M. Comparison of the chelipeds of two crayfish species, *Astacus leptodactylus* Eschscholtz and *Pacifastacus leniusculus* (Dana). *Ege Journal of Fisheries and Aquatic sciences* 2000; 17 (1-2): 47-56.

- [34] Wang, Q., Yang, W., Zhou, G., Zhu, Y. and San, H. Length-weight and chelae lengthwidth relationships of the crayfish *Procambarus clarkii* under culture conditions. *Journal of Freshwater Ecology*, 2011; 26: 287-294.
- [35] Köksal, G. *Astacus leptodactylus* in Europe. In: *Freshwater Crayfish: Biology, Management and Exploitation* (ed. by D.M. Holdich & R.S. Lowery). Chapman & Hall, London, 1988; 365-400.
- [36] Austin, C.M. Length-weight relationships of cultured species of Australian freshwater crayfish of the genus *Cherax*. *Freshwater Crayfish* 1995; 10: 410-418.
- [37] Deniz, T., Harlioğlu, M.M. and Deval, M.C. A Study on the Morphometric Characteristics of *Astacus leptodactylus* Inhabiting in the Thrace Region of Turkey. *Knowledge and Management of Aquatic Ecosystems* 2010; 397, 05, DOI: 10.1051/kmae/2010021.
- [38] Aydın, H., Harlioğlu, M.M. and Deniz, T. An investigation on the population parameters of freshwater crayfish (*Astacus leptodactylus* Esch., 1823) in Lake Iznik (Bursa). *Turk J Zool* 2015; 39: 660-668.
- [39] Weya, J. M., Rumbiak, N. S., Hariyanto, S., Irawan, B. and Soegianto, A. Length-weight relationship and condition factor of crayfish from South Sorong and Jayawijaya, Papua, Indonesia. *Croatian Journal of Fisheries*, 2017; 75: 31-40.
- [40] Lindqvist, O. V., Lahti, E. On the sexual dimorphism and condition index in the crayfish, *Astacus astacus* L., in Finland. *Freshwater Crayfish*, 1983; 5: 3-11.
- [41] Streissl, F., Hodl, W. Growth, morphometrics, size at maturity, sexual dimorphism and condition index of *Austropotamobius torrentium* Schrank. *Hydrobiologia*, 2002; 477: 201-208.
- [42] Simon, T. P., Stewart, C. R. Growth, length-weight relationships, and condition associated with gender and sexual stage in the invasive northern crayfish, *Orconectes virilis* Hagen, 1870 (Decapoda, Cambaridae). *Proceedings of the Indiana Academy of Science*, 2014; 123(2): 1-8.
- [43] Anderson, W.E., Simon T.P. Length-weight Relationship, Body Morphometrics, and Condition Based on Sexual Stage in the Rusty Crayfish, *Orconectes rusticus* Girard, 1852 (Decapoda, Cambaridae) with Emphasis on Management Implications. *Fisheries and Aquaculture Journal*, 2015; 6, 3, 7 p. DOI: 10.4172/2150-3508.1000129
- [44] Çetinkaya, O. Balık Besleme. Yüzüncü Yıl University. Ziraat Fakültesi, Van, 1995.