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Seasonal variation of gender-specific meat yield of freshwater Crayfish (*Pontastacus leptodactylus* Eschscholtz, 1823)

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ABSTRACT
The focus of this study was the seasonal and sex-specific variation in meat yield of narrow-clawed crayfish (*Pontastacus leptodactylus* Eschscholtz, 1823), an important crustacean species for aquaculture and the local market. This popular consumer product has been the subject of much recent research. Crayfish were caught from Cernek lake in October–November and May–June 2021–2022 using a pinter. A total of 400 crayfish were included in the study, of which 224 were male and 176 were female. Important data on crayfish under and above 35 g were obtained. The average meat yield was 15.79% in the period October-November and 15.30% in the period May–June. The average of the total meat yield was 15.55%. As a result of the crayfish meat yield study, 100 g of consumable meat was obtained from approximately 13.17 individuals. Carapace length was found to have a statistically significant coefficient in the determination of total meat yield. The results of the study will support demand increases in the local market and have a beneficial impact on aquaculture businesses.

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KEYWORDS
Crayfish; *Pontastacus leptodactylus*; meat yield; seasons

1. Introduction

Crayfish are represented by 737 species and subspecies worldwide (Crandall and De Grave 2017). Approximately 15 of these species are of economic importance (Ackefors 2000). Although there are quite a lot of species, they are generally known as families (Parastacidae, Cambaridae, Astacidae), which are important in fishing and aquaculture. Crayfish are important not only for farming but also for biogeography, ecological characteristics and even for assessing their invasiveness (Lele and Pârvulescu 2017). Some crayfish belonging to the genus Astacus (*P. leptodactylus* and *A. astacus*) have a high economic value and are widely distributed in Europe. *A. astacus* is found in 28 European countries, from France to southeastern Russia, Italy, Greece and Scandinavia. *Pontastacus leptodactylus* is distributed in Turkey, Ukraine, Southwest Russia, Iran, Kazakhstan, Belarus, Slovakia, Bulgaria, Romania and Hungary. To date, this species has been recorded in at least 27 countries. In addition, it has been stocked in 14 countries (Czech Republic, Poland, Germany, Finland, Denmark, Netherlands, United Kingdom, Lithuania, Latvia, France, Switzerland, Austria, Spain and Italy) (Alvanou et al. 2022; Dvoretsky and Dvoretsky 2023; M. M. Harlioğlu 2004). In addition, the Crayfish World platform displays the accurate distribution of over 400 species, as determined by scientific data (Ion et al. 2024).

In the literature, the terms used by traders in commercial fishing centres for *Pontastacus leptodactylus* crayfish in Turkey are undersized, dead, soft-shelled, missing limbs, lesioned, algae covered. Furthermore, 77.2 ± 4.1% of the commercial catch in Turkey was reported as incidental catch, which is 40.4% higher than the global incidental catch rate (Çapkın et al. 2023). Freshwater crayfish are one of the most important aquatic species in terms of sustainability and maintaining the integrity of the freshwater ecosystem (Alvanou et al. 2022). Many organisms develop strategies to protect themselves from stressful environmental factors and biological threats, expending significant amounts of energy in the process. Shelter is crucial for the ecology of many species. Vulnerable species, such as crayfish, depend on specialized shelter types for protection from predators. Similarly, crayfish cultivated in aquaculture require shelter for their protective instinct (Neculae et al. 2024).

Crayfish culture is based on self-sustaining populations with a feed-based food system. Research for sustainable crayfish meat has reported that stocking density on crayfish reduces growth, survival and production. Therefore, it is necessary to implement a crayfish management strategy for sustainable crayfish and crayfish meat production. In addition, conditions such as food, shelter and stocking density affect the larval production of crayfish (He et al. 2021; Mazlum and Uzun 2022). Narrow-clawed crayfish is an ecologically and economically important crayfish species worldwide, and is one of the products exported from Turkey inland waters. *P. leptodactylus* is listed as 'Least Concern' on the IUCN Red List of Threatened Species and is cultivated in astaciculture (Gherardi and Souty-Grosset 2017; Đuretanović et al. 2023). Crayfish are known as an important component of wetlands due to their place in the food chain and their important role in the functioning of freshwater ecosystems (Momot 1995; Kozák et al. 2011; Safari et al. 2022; Yücel and Kılıç 2022). Furthermore, invasion is the most significant issue affecting the distribution of native

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species. European crayfish have low numbers of species and are vulnerable to invasion by North American crayfish. The spiny-cheeked crayfish (*Orconectes limosus*), for example, competes very well with the native European crayfish (*Pontastacus leptodactylus*). However, while the fecundity of the native species remained stable, the number of eggs produced by the invasive females increased significantly. The invasive species produced 1156 eggs, compared to 886 for the native species (Pârvulescu et al. 2015).

The characteristics of the narrow-clawed crayfish populations of lakes Gin'kovo and Sominskoye in Belarus and Lake Sevan in Armenia have been analysed in the literature. In the Belarusian population, mating and spawning on pleopods occurs in late October-early November, while in the Sevan population it occurs in early April; the reproductive capacity of the Sevan population is 1.5 times higher than that of the Belarusian population (Alekhnovich and Ghukasian 2014).

In the literature, the crayfish *Procambarus virginalis* Lyko, captured from an anthropogenic lake environment in northern Croatia, was observed to have pleopodal eggs individuals in June and September, despite regular reproductive records of active females (Dobrović et al. 2021). Developments in these studies can also be seen in other crayfish species.

It has been reported in the literature that substances that improve immune activity and alleviate oxidative stress may be suitable dietary supplements for crayfish. This may have a positive effect on the meat yield of crayfish (An et al. 2020). Crayfish meat contains high amounts of Na, K, Ca and Mg elements, vitamin B and vitamin C. It contains more carotene than most fish species and is a low-calorie protein source (A. G. Harlioğlu et al. 2012). It was reported that different meat productivity values were obtained as a result of meat productivity studies of crayfish in different geographical regions (Boyalık et al. 2023; Yang et al. 2023; Zhang et al. 2023; Gültepe et al. 2024). Crayfish reach sexual maturity at around three years of age and the average weight at this age is 35 g and this weight is the market weight (Cìlbìz 2020). Male narrow-clawed crayfish *Pontastacus leptodactylus* weighing 30–35 g were used in the study. They were caught between July and December in the Agın region of Keban Dam, Turkey (Öz and Karatepe 2017). For narrow-clawed crayfish, 35 g is an average catch weight. In order to give each individual the chance to reproduce at least once and to take into account the market sales weight, the study was planned by grouping the individuals with weights below 35 and 35 g and above. During the periods when females were carrying eggs, egg weights were considered to be effective on the total weight of the crayfish, so sampling was not carried out during these periods.

In this study, crayfish were used that were caught in the Cernek lake in the district of Bafra in the province of Samsun in Turkey. The crayfish were caught in October–November and May–June, when the female crayfish had completed their spawning period. The aim of this study was to determine the differences in length, weight and meat yield of *Pontastacus leptodactylus* Eschscholtz, 1823 in October–November and May–June seasons by grouping the species as under 35 and 35 g and above according to body weight. These results will contribute to the local market and potential aquaculture sector.

2. Materials and methods

2.1. Investigated area

The crayfish were caught in Cernek lake of the Bafra fish lakes of Turkey. The deepest part of the lake is 3 m and the average depth is 1.5 m. The lake is very rich in plankton. The lowest water temperature in the lake was 5.98 ± 0.03°C. The highest temperature was 25.09 ± 0.06°C. The lowest dissolved oxygen was 5.50 ± 0.02 mg/L and the highest was 8.40 ± 0.06 mg/L. The lowest pH was 7.20 ± 0.05 and the highest was 8.90 ± 0.06. The locations of the lakes where crayfish were caught are shown in Figure 1. HGM Atlas applications were used to create the map showing the locations where crayfish were caught.

2.2. Sample collection

In the study, crayfish were sampled by random sampling method among healthy crayfish caught with fyke-nets in Cernek Lake in October–November 2021 and May–June 2022. Crayfish were selected to be free of lesions and to be actively moving. A total of 400 crayfish (224 males and 176 females) were used in the study. Crayfish collected from the lake were transported in humidified styrofoam boxes containing sufficient number of ice cubes and brought to the laboratory of Sinop University, Faculty of Fisheries. Figure 2(a) is an image of the crayfish under study. Figure 2(b) shows a technical image of a male crayfish with limb names. The limb names of the crayfish found in the literature were analysed and shown in Figure 2(b).

2.3. Preparation of samples

Samples were weighed using a 0.0001 g electronic balance (Radwag/AS 220-C-2, Poland). A sensitive digital caliper (Mitutoyo 500-196-20 Absolute Digimatic Caliper, 0-6"/150 mm) was used to measure the length of the samples (from the tip of the rostrum to the tip of the telson). 400 crayfish were sampled during the study. The average weight of a narrow-clawed crayfish is 35 g. This weight was therefore used in the study. Crayfish were grouped according to sex and body weight as below 35 and 35 g and above. In the aquaculture laboratories of Sinop University, the crayfish used in the study were separated from their meat under sterile conditions.

In order to examine the meat yield of crayfish, the abdomen and claw were cut with the help of scissors, the meat was removed with pliers and weighed separately on a 0.0001 g precision balance and the meat yield was determined using the following Equation (1) (Rhodes and Holdich 1984; Gu et al. 1994). The meat of the crayfish was weighed as wet weight and meat yield was determined in this way.

$$\text{Meat yield (\%)} = \frac{(\text{Meat weight (Abdomen + Total claws) (g)})}{(\text{Total weight (g)})} \times 100 \tag{1}$$

The average meat yield of the crayfish studied was determined and the number of crayfish required to reach the average consumption value was determined by modelling. In this modelling the value of mg/100 g portion used by Weihrauch et al.

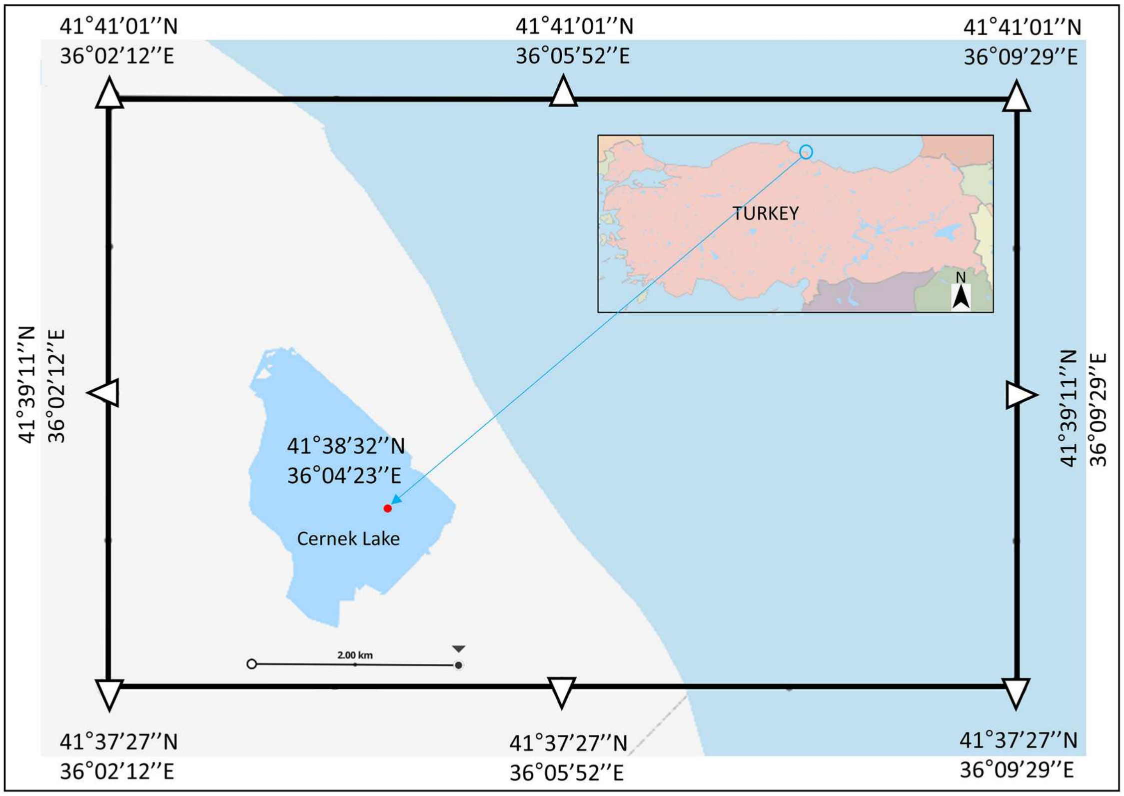

Figure 1. The sampling area.

(1977) was used (Weihrauch et al. 1977). For this study, the average meat yield of the crayfish in g was used to calculate how many crayfish were needed to obtain 100 g of meat. The meat yield per individual and the number of individuals required to produce 100 g of crayfish meat were modelled using Excel software.

2.4. Data analysis

The data obtained from the seasonal analyses were subjected to statistical analysis. The statistical significance of the length–weight relationship and meat yield of the crayfish used in the study was investigated. The proportional changes of carapace length, abdominal length and claw length on meat yield were analysed. The mean and proportional values of carapace meat yield, abdominal meat yield and total meat yield were analysed separately for male and female crayfish. Descriptive statistics and regression analyses were performed. SPSS 21 and MINITAB 17 statistical packages were used for regression analysis. Microsoft Office 2010 programmes were used for descriptive statistics. The significance value was taken as $p < 0.05$.

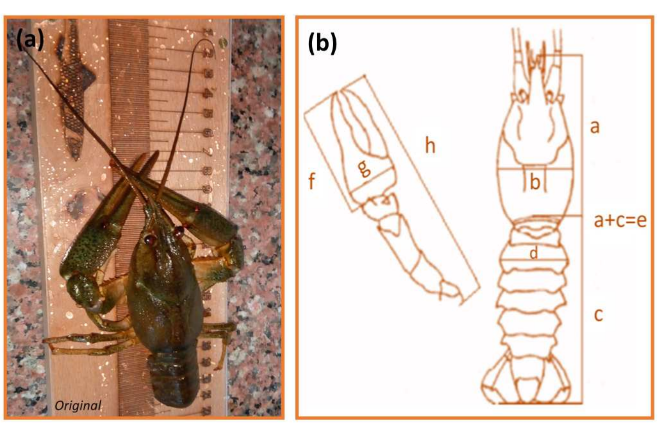

Figure 2. (a) Crayfish (*Pontastacus leptodactylus* Eschscholtz, 1823) used in the study. (b) a:Carapace length, b:carapace width, c:abdomen length, d:abdomen width, e:total length, f:claw length, g:claw width and h:claw foot length measured in crayfish (Rhodes and Holdich 1984).

3. Results

3.1. Length–weight relationship

The crayfish used in the study were successfully caught with a pinter in October–November and May–June. The captured crayfish were separated by sex. Length and weight measurements were taken and then meat yield analyses were carried out. In this study, 44% of the crayfish analysed were female crayfish. Crayfish were grouped according to sex and body weight as below 35 and 35 g and above. The values obtained as a result of regression analysis applied to the data obtained are given in Table 1. When the grouping was evaluated according to sex, it was determined that the average length of female crayfish was 10.30 ± 0.23 cm and weight was 31.78 ± 2.00 g, while the average length of male crayfish was 10.17 ± 0.18 cm and weight was 37.61 ± 2.02 g. In October–November, the average length of female crayfish under 35 g was 9.33 ± 0.23 cm and their weight was 23.53 ± 1.63 g, the average length of male crayfish was 9.41 ± 0.17 cm and their weight

Table 1. Regression values by categories (months, gender, weight).

	October–November		May–June	
	35-	35+	35-	35+
FEMALE	F = 12.77; (p = 0.005) T-meat = −7.04 + 0.2387CL r = 71.90 F_{1-10} = 20.91; (p = 0.001) T-meat = −5.85 + 0.2060 AL r = 80.26 F = 18.13; (p = 0.002) A-meat = −5.77 + 0.1998CL r = 78.04 F = 33.67; (p = 0.000) A-meat = −4.84 + 0.1738AL r = 87.70	F = 8.51; (p = 0.015) T-meat = −6.58 + 0.2434CL r = 63.69 F = 8.09; (p = 0.017) T-meat = −8.47 + 0.2541 AL r = 62.61 F = 8.00; (p = 0.018) A-meat = −5.77 + 0.2066 CL r = 62.35 F = 7.83; (p = 0.020) A-meat = −7.39 + 0.2184 AL r = 61.32	F = 49.84; (p = 0.000) T-meat = −5.68 + 0.1984CL r = 84.85 F = 63.22; (p = 0.000) T-meat = −3.982 + 0.1508AL r = 87.53 F = 42.31; (p = 0.000) A-meat = −4.79 + 0.1705 CL r = 82.76 F = 61.50; (p = 0.000) A-meat = −3.458 + 0.1323AL r = 87.24	F = 5.35; (p = 0.082) T-meat = −5.14 + 0.1986 CL r = 68.22 F = 3.38; (p = 0.140) T-meat = −10.24 + 0.259 AL r = 56.77 F = 8.77; (p = 0.041) A-meat = −8.58 + 0.2443CL r = 78.00 F = 1.61; (p = 0.273) A-meat = −9.2 + 0.231 AL r = 33.03
MALE	F_{1-15} = 59.39; (p = 0.000) T-meat = −8.64 + 0.2644CL r = 88.59 F = 35.42; (p = 0.00) T-meat = −10.29 + 0.3100AL r = 82.63 F = 34.90; (p = 0.000) A-meat = −3.47 + 0.1324CL r = 82.42 F = 23.62; (p = 0.000) A-meat = −4.27 + 0.1547AL r = 76.53	F_1 = 16.93; (p = 0.000) T-meat = −10.48 + 0.3175CL r = 60.22 F = 40.34; (p = 0.00) T-meat = −14.64 + 0.4127 AL r = 76.43 F = 35.49; (p = 0.00) A-meat = −6.40 + 0.1949 CL r = 74.29 F = 104.43; (p = 0.000) A-meat = −8.24 + 0.2403 AL r = 88.71	F_{1-10} = 4.83; (p = 0.049) T-meat = −0.49 + 0.0787 CL r = 49.17 F = 69.10; (p = 0.000) T-meat = − 6.73 + 0.2178 AL r = 92.21 F = 5.53; (p = 0.038) A-meat = 0.249 + 0.0443 CL r = 52.35 F = 28.20; (p = 0.000) A-meat = −2.587 + 0.1069 AL r = 83.30	F_{1-10} = 4.34; (p = 0.106) T-meat = −28.2 + 0.587 CL r = 63.28 F = 30.03; (p = 0.005) T-meat = − 48.9 + 0.935 AL r = 92.26 F = 0.24; (p = 0.653) A-meat = + 1.95 + 0.064 CL r = 0 F = 0.03; (p = 0.869) A-meat = −7.43-0.029 AL r = 0

Note: Abbreviations used in Table 1: T-meat = Total meat, A-meat = Abdomen meat, CL = Carapace length, AL = Abdomen length.

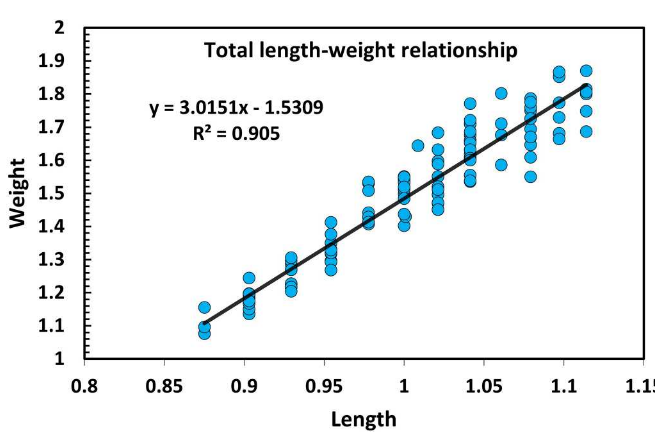

Figure 3. Length-weight relationship in all crayfish (log).

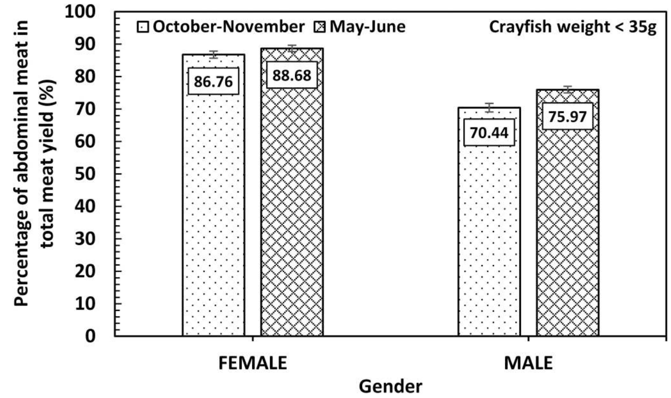

Figure 4. The ratio of abdominal meat to total meat yield in crayfish weighing less than 35 g (%).

was 27.73 ± 1.56, 35 g and over, female crayfish had an average length of 12.08 ± 0.23 cm and weight of 50.47 ± 2.76 g, male crayfish had an average length of 11.16 ± 0.15 cm and weight of 49.91 ± 2.10 g. In May–June, the average lengths of female crayfish under 35 g were 9.28 ± 0.23 cm and weights were 22.36 ± 1.52 g, the average lengths of male crayfish were 8.31 ± 0.20 cm and weights were 23.72 ± 1.54 g, 35 g and over, female crayfish had an average length of 12.08 ± 0.27 cm and weight of 42.29 ± 2.35 g, male crayfish had an average length of 11.58 ± 0.27 cm and weight of 49.23 ± 3.21 g. In the Figure 3, although it can be said that the values between the length and weight of male and female crayfish under 35 g are close to each other, it cannot be said that there is a close similarity between the sexes in crayfish 35 g and above. The length–weight relationship of all crayfish showed allometric growth in regression analysis.

3.2. Statistics

In the Table 1, when evaluated according to sex and from the crayfish, it was found that male crayfish had better growth performance. When the relationship between total meat yield and carapace and abdominal length, abdominal meat yield and carapace and abdominal length were analysed; 35 g and over in both female and male crayfish, it was determined that there was no relationship between total meat and carapace and abdominal lengths in May–June, and there was no relationship between total meat and carapace length, abdominal meat and abdominal lengths in male crayfish over 35 g in May–June (p > 0.05).

In addition, it was determined that total meat carapace and abdomen lengths, abdominal meat carapace length and abdominal meat-abdomen lengths had a significant coefficient of determination (r) in explaining meat yields in all cases where there was a relationship.

3.3. Meat yield

In crayfish, claw meat yield is less than abdominal meat yield. However, it can be said that the proportional difference between claw meat yield and abdominal meat yield in male crayfish weighing 35 g and more is close to each other.

In Figure 4, the proportion of abdominal meat in the total meat yield of crayfish less than 35 g was 86.76% for female crayfish and 70.44% for male crayfish in the October–November period. In May–June, it was 88.68% for the female crayfish and 75.97% for the male crayfish.

In Figure 5, the proportion of abdominal meat in total meat yield of crayfish over 35 g was 82.44% for females and 61.78% for males in October–November. In May–June it was 88.17% for female crayfish and 91.68% for male crayfish.

As can be seen from the examination of Figures 4 and 5, the yield of abdominal meat makes up a large proportion of the total amount of meat in the crayfish. It can be understood that this situation does not lead to a difference between the meat yield of male and female crayfish ($p > 0.05$). In Figure 6, in October–November, the ratio of total meat yield to body weight was 17.28% for females and 15.10% for males in crayfish under 35 g. In May–June the ratio was 15.31% for females and 15.02% for males.

In Figure 7, in October–November, the ratio of total meat yield to body weight was 15.04% for females and 15.77% for males in crayfish over 35 g. In May–June, the ratio was 15.34% for female crayfish and 15.54% for male crayfish.

In the Figure 8, there is no statistical difference between the proportional values of total meat yield and body weights at all times and between sexes ($p > 0.05$). Claw meat yield is lower than abdominal meat yield in crayfish. However, it can be said that the proportional difference between claw meat yield and abdominal meat yield in male crayfish weighing 35 g and more is close to each other. On the other hand, the period when the difference between abdominal meat yield and claw meat yield was the highest in female crayfish was May–June.

In the Figure 8, it was determined that there was no statistically significant difference between the abdominal lengths of male and female crayfish ($p < 0.05$), while the difference between the claw lengths was statistically significant ($p > 0.05$).

In the Figure 9, in female crayfish 35 g and above, the total amount of meat was higher in October–November compared to May–June. However, in crayfish under 35 g, the total amount of meat was close to each other in October–November and May–June.

Although the proportional meat levels of female crayfish did not change, it was determined that there was a significant decrease of 20% in average body weight in May–June compared to October–November. This situation is thought to be due to the fact that the crayfish do not give their energy to feeding during the egg carrying process.

In the current study, it was determined that carapace length, which has a significant effect in explaining total meat yield, also has a statistically significant coefficient of determination. It was determined that the proportional meat levels did not change between time and sexes in narrow-clawed crayfish.

Using the values obtained from the crayfish meat yield, the number of crayfish required to obtain 100 g of meat in different periods was modelled. Figure 10 (a) shows the average amount of meat in one crayfish in October–November and May–June ($x < 35$: crayfish less than 35 g), ($x > 35$: crayfish greater than 35 g), (All x: all crayfish). Figure 10 (b) and (c) shows the number of crayfish needed to reach a weight of 100 g in 3 groups in October–November and May–June.

When analysing the meat yield values per individual in Figure 10 (a), the October–November months showed a higher yield than the May–June months in 3 groups. Therefore, October–November seems to be the best harvesting period in terms of meat yield in Figure 10 (a). In Figure 10 (b), the average number of individuals required to produce 100 g of edible crayfish meat was determined to be 17.16. In Figure 10 (c), the average number of individuals was found to be 20.04. In the period October–November this value can be reached with about 13.17 crayfish, while in the period May–June this value can be reached with about 15.24 crayfish.

4. Discussion

This investigation presents the results of the abdominal, claw and total meat yields of freshwater crayfish, which were found to be gender-specific during the October–November and May–June seasons. The results showed that freshwater crayfish have a significant meat yield rate. Crustaceans and their derivatives are an important and sustainable part of economic development, aesthetics and gastronomy (Nugroho Susanto 2021; Amiri et al. 2022).

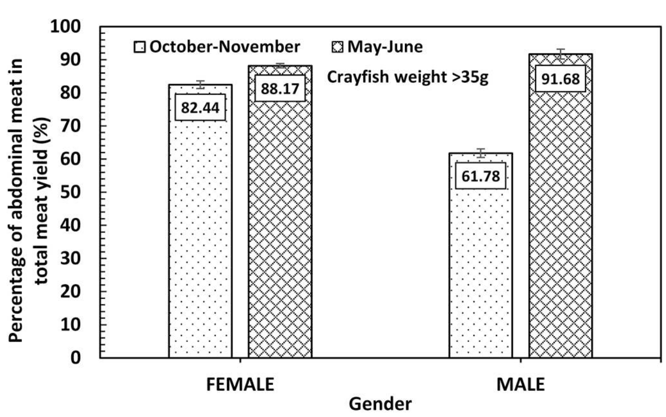

Figure 5. The ratio of abdominal meat to total meat yield in crayfish weighing more than 35 g (%).

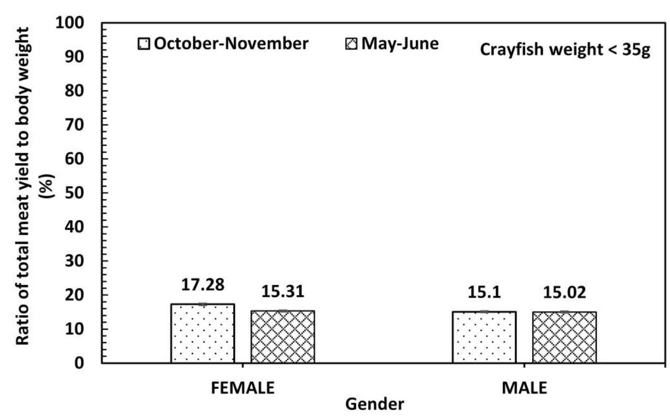

Figure 6. Ratio of total meat yield to body weight in crayfish weighing less than 35 g (%).

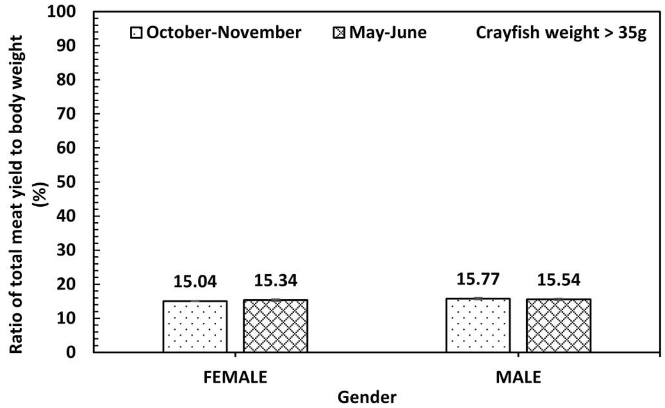

Figure 7. The ratio of total meat yield to body weight in crayfish weighing more than 35 g (%).

The gender distribution of the crayfish used in the experiments was 44% female and 56% male. In similar studies, the proportions of female crayfish were determined as 43% by (Bolat and Kaya 2016) and 40% by (Dirican 2018). The amount of meat obtained from crayfish can vary according to reproductive maturity, gender, length and weight, species and food chain supply, as well as the time of capture.

Berber et al., the highest value for total meat yield was 19.76% and the highest value for abdominal meat yield was found to be 16.08% in female individuals. In male individuals, the highest value for total meat yield was 20.43% and the highest value for abdominal meat yield was found to be 14.28%. Although the mean abdominal meat yield was higher in females, the total meat yield of male crayfish was higher (Berber et al. 2020). Farhadi et al., a significant positive correlation was found between the weight and length of *Pontastacus leptodactylus* Eschscholtz, 1823 (Farhadi et al. 2019).

In the study, the highest ratio of total meat yield to body weight was 17.28% in female crayfish less than 35 g in October–November and the lowest ratio was 15.02% in males in May–June.

Büyükçapar et al., reported total meat ratios of 12.76% and 14.83% for females and males, respectively. Also, the abdominal meat of females accounted for 10.15% (3.33 ± 0.25 g) of the body weight, while this ratio was found to be 9.55% (3.85 ± 0.23 g) in males (Büyükçapar et al. 2006).

Aksu & Kurt Kaya, reported that abdominal meat, claw meat and total meat yield of male crayfish caught from Lake Aktas were 10.03%, 4.60% and 14.63%, respectively, while abdominal meat, claw meat and total meat yield of females were 11.59%, 2.73% and 14.32%, respectively. The r-values between abdominal meat yield, total meat yield and carapace length of male crayfish were found to be 0.737 and 0.0694, while those of females were 0.683 and 0.730, respectively (Aksu and Kurt Kaya 2017).

In a study by Harlioglu & Holdich on *P. leptodactylus*, the amount of meat removed from the abdomen of males and females was found to be close, while the amount of meat removed from the claw of males was found to be quite different from that of females (M. M. Harlioğlu and Holdich 2001).

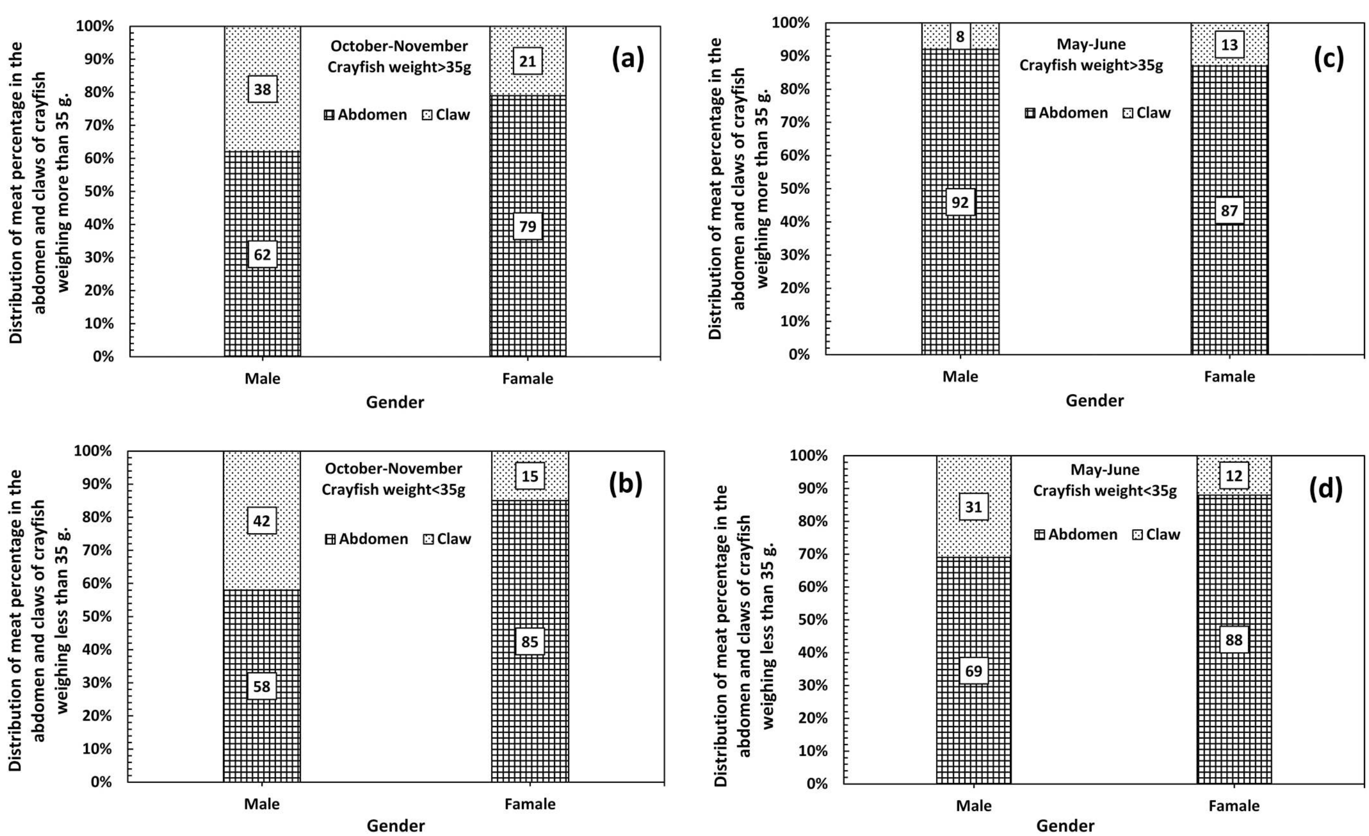

Figure 8. Abdominal and claw meat yield values (%), in October–November (a) Less than 35 g (b) Greater than 35 g and in May–June (c) Less than 35 g (d) Greater than 35 g.

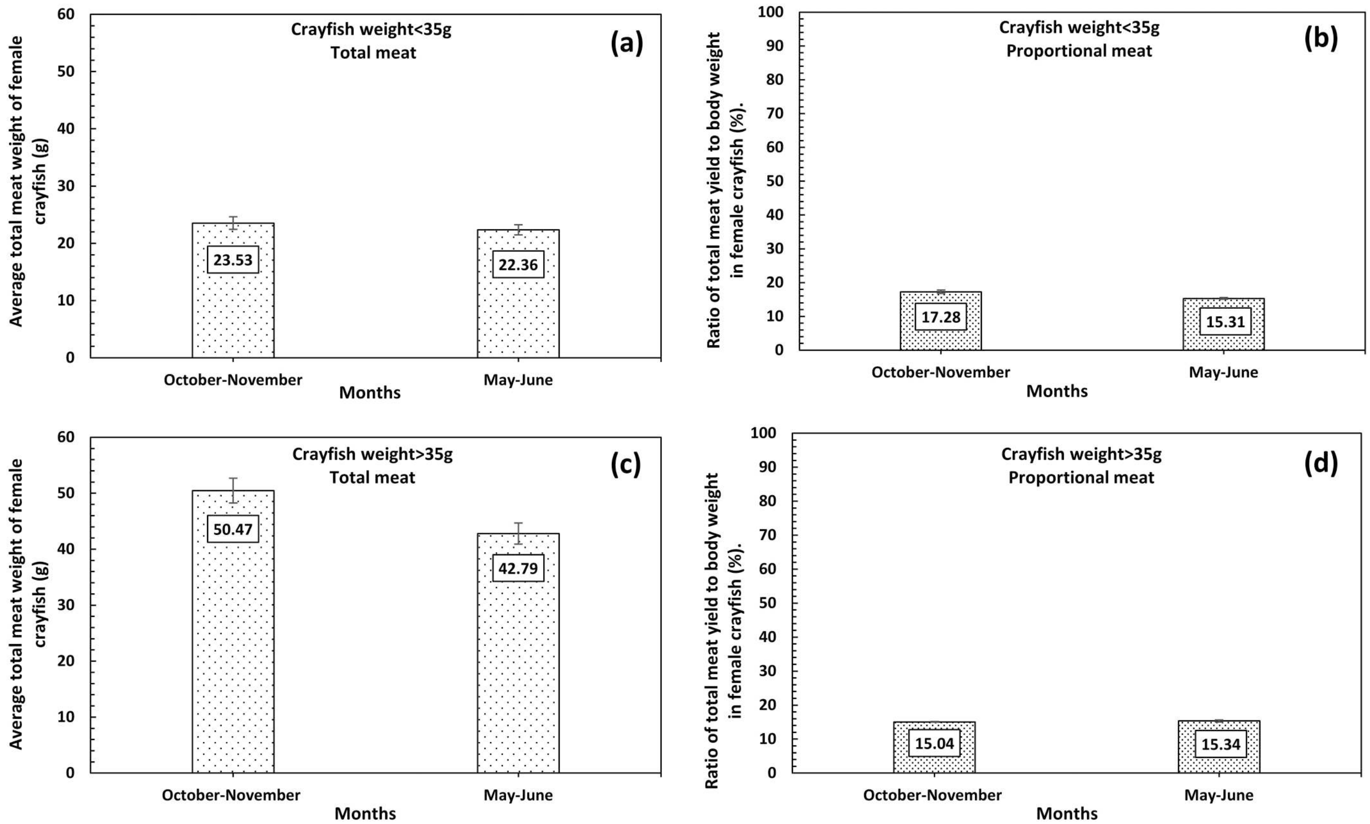

Figure 9. (a) Total meat weight of crayfish weighing less than 35 g. (b) Proportional meat percentage of crayfish weighing less than 35 g. (c) Total meat weight of crayfish weighing more than 35 g. (d) Proportional meat percentage of crayfish weighing more than 35 g.

Aksu et al., observed a linear relationship between abdominal meat yield and shell length of male and female crayfish in Keban Dam Lake (Aksu and Kutluyer 2019).

Harlioğlu & Holdich found a linear relationship between abdominal meat yield and shell length, and a linear and strong relationship between abdominal and total meat content and carapace length of *P. leptodactylus* in UK waters (M. M. Harlioğlu and Holdich 2001). Yılmaz et al., found a linear and strong relationship between abdominal and total meat yield and carapace length in Keban Dam, and determined that abdominal meat yield increased in direct proportion to carapace length in male crayfish, while there was no linear relationship in females (Yılmaz et al. 2011).

Boyalık et al., the percentage of meat yield in total weight was reported to be 13.85% for female crayfish and 14.64% for male crayfish (Boyalık et al. 2023). Berber et al., the mean carapace length of female individuals was 52.34 mm and the total weight was 34.16 g. The mean carapace length and total weight of male individuals were 61.34 mm and 43.25 g, respectively. It has been reported that total weight increases with increasing carapace length (Berber et al. 2020).

In this investigated, the 100 g portion size in mg/100 g portion used by Weihrauch et al. (1977) in the fatty acid conversion factor study was used to determine the average meat content of 1 crayfish (Weihrauch et al. 1977). It was observed that the average meat content of one crayfish was lower in May–June than in October–November. When the reason for this was investigated, Baudry et al., reported that the vital activity of crayfish varies according to water temperature and environmental factors. Low activity in winter and moulting in May–June were reported. In addition, high activity in summer, moulting and breeding periods before winter were explained (Troth et al. 2021; Baudry et al. 2023).

Differences in nutrient composition depend on many factors such as species, gender, body size, diet, season and stage of development. The sex difference in particular has a major impact due to the difference in energy allocated for reproduction; females may spend 20-25% of their pre-breeding weight on gonads, while males may spend only 3-9% (Jonsson et al. 1991; Fleming 1996). When the results of the study were examined, it was found that the ecological environment and habitat are of great importance for efficient crayfish production.

Conclusions

The seasonal meat yield of the narrow-clawed crayfish (*Pontastacus leptodactylus* Eschscholtz, 1823) was analysed, and the results are presented below.

The average ratio of meat yield to body weight was 15.79% in October–November and 15.30% in May–June, and the average meat yield ratio of the two periods was 15.55%.

The highest total meat yield to body weight ratio was found in female crayfish weighing less than 35 g, at 17.28%, in October–November. The lowest total meat yield to body weight ratio of 15.02% was found in male crayfish smaller than 35 g in May–June.

It was determined that the proportional meat levels did not change according to time and sex, but the average body

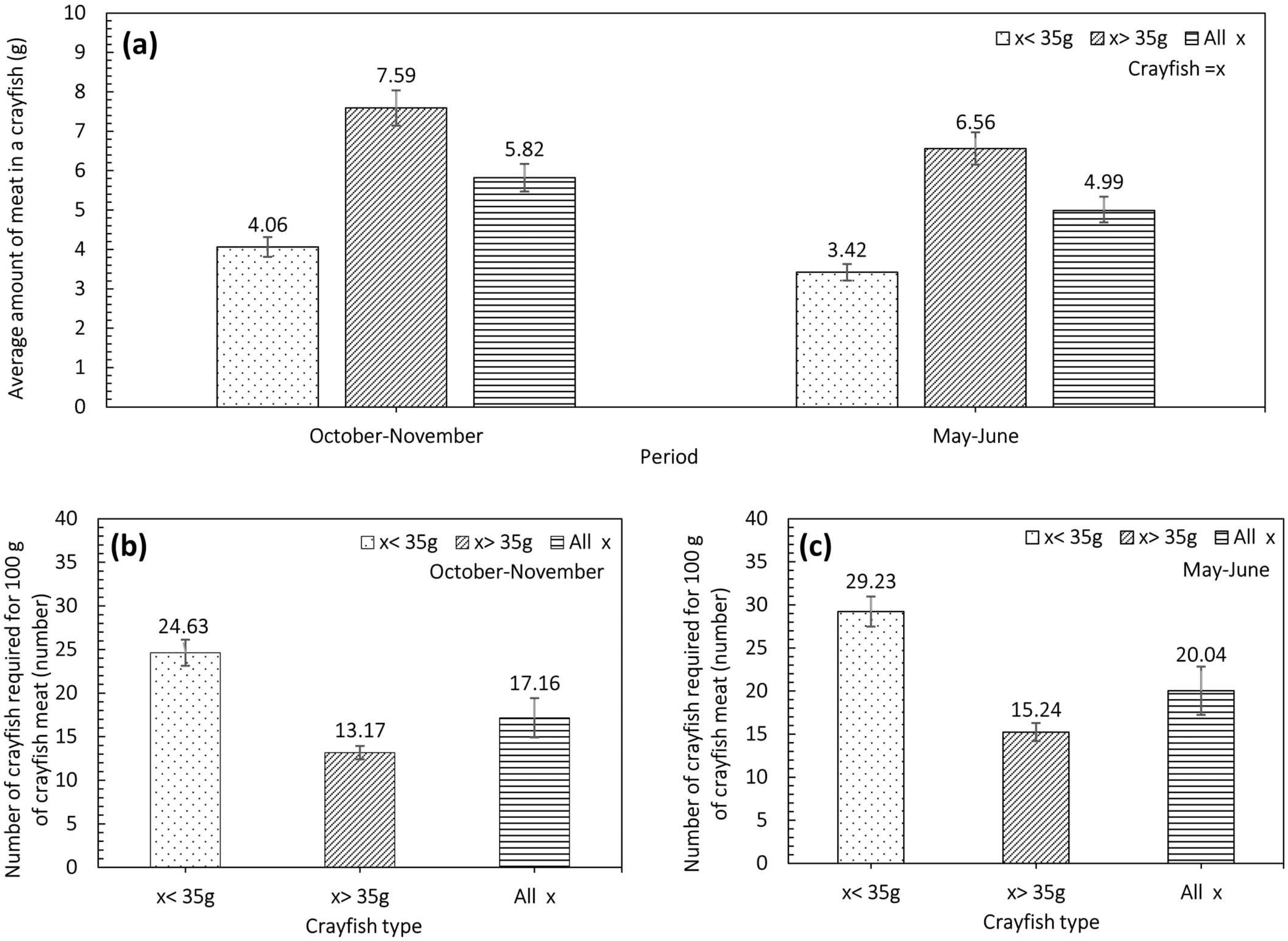

Figure 10. (a) Average amount of meat in a crayfish (g). (b) Number of crayfish required for 100 g of crayfish meat in October–November. (c) Number of crayfish required for 100 g of crayfish meat in May–June.

weight of female crayfish decreased by 20% in May–June during the egg transportation period due to excess energy consumption.

In crayfish, claw meat yield was less than abdominal meat yield, but the proportional value between claw and abdominal meat yield was close in male crayfish above 35 g. Total meat yield increased with increasing carapax length and this was found to be statistically significant.

As a result of the study of the average amount of meat obtained from 1 crayfish, 100 g, 1 portion of meat can be obtained with approximately 13.17 individuals. As a result of this research, important results were obtained in terms of the local market and aquaculture in terms of the species (*Pontastacus leptodactylus* Eschscholtz, 1823), which is an important consumer product.

Based on the environmental data obtained from the study, it is important to apply sustainable fishing for the quality of crayfish caught from nature and to protect the ecological environment in which crayfish live.

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Disclosure statement

No potential conflict of interest was reported by the author.

Data access information

All data are presented in the article as data access information.

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