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ORIGINAL ARTICLE

# Feeding characters of *Alburnus sellal* (Family: Leuciscidae) in the Little Zab River, western Iran

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**Abstract**
The feeding characteristics of *Alburnus sellal* in the Little Zab River, west Azarbaijan Province, Iran were studied from November 2021 to October 2022. The specimens were collected and anesthetized in 1% clove oil, fixed in 10% buffered formalin, and transferred to the laboratory. The average condition factor for males and females was 0.85 showing a significant difference between different months in both sexes ($P$<0.05). The average length and weight for all specimens were 11.36±1.95cm and 11.8±7.14g, respectively. The average length of gut (RLG) for all fish was 0.65±0.11 during the year. The mean RLG in different months showed significant differences ($P$<0.05). The highest Gastrosomatic index value was recorded in January and those lowest in August and showed significant differences in different months ($P$<0.05). A total of 34 empty stomachs were observed amongst the 95 specimens and there were significant differences in different months ($P$<0.05). This species is an omnivorous fish that mainly consumes aquatic insects, aquatic plants, algae, diatoms, and organic decay material with modest feeding throughout the year.

**Keywords:** Relative length of gut, Gastrointestinal vacancy index, Feeding habit, Condition factor.

## INTRODUCTION

Feeding is one of the most important functions of an organism to be healthy and productive. Basic functions such as development, growth, reproduction, etc. all occur at the expense of the energy, which is received by organisms in the form of food. Therefore, feeding activities influence the growth and productivity of fish (Kurbah & Bhuyan 2018). Knowledge of feeding habits of fish species is important for understanding the ecological role and productive capacity of fish populations which is crucial to the development of conservation and ecosystem-based management plans (Alimohammadi et al. 2020). Understanding fish feeding habits requires extensive field and laboratory studies to infer a species' main nutrition sources. Even then, feeding studies can identify the prevalence of food items. However, it is impossible to assess fish's diet preferences without detailed complementary studies to estimate the range and abundance of potential food items available in their natural environment (Jorfipour et al. 2022).

*Alburnus sellal* is a native species of the Leuciscidae family in the Tigris, Zohre, Persis, and Hormuz basins of Iranian inland waters (Keivany et al. 2016; Eagderi et al. 2022; Mouludi-Saleh et al. 2022) and also the Tigris and Euphrates river system (Persian Gulf basin) of neighboring countries of Iran (Froese & Pauly 2020; Çiçek et al. 2023). In addition, *A. sellal* is widely distributed in the Qweik River of Turkey (Eagderi et al. 2019). Due to the wide distribution of this species in the Middle East, this study was conducted to provide some information on its feeding characteristics in the Little Zab River.

## MATERIAL AND METHODS

A total of 95 specimens of *A. sellal* were sampled monthly from November 2021 to October 2022 from the Iranian Part of Little Zab River using an electrofishing device (Samus MP750). Samples were anesthetized in 1% clove oil, fixed in 10% buffered formalin, and transferred to the laboratory. After measuring the total length (cm) and standard length with an accuracy of 0.01 and body weight with an

**Table 1.** Total length (TL) and body weight (W) (mean±SD) of male and female specimens of Alburnus sellal from the Little Zab River.

| Gender | Total length (cm) | | Total weight (g) | |
|---|---|---|---|---|
| | Range | Mean±SD | Range | Mean±SD |
| Male | 6.76-16.18 | 10.80±2.02 | 2.7-34.3 | 11.95±6.88 |
| Female | 7.78-15.17 | 12.00±1.66 | 4.1-35 | 15.55±7.02 |
| Total | 6.76-16.18 | 11.36±1.95 | 2.7-35 | 11.8±7.14 |

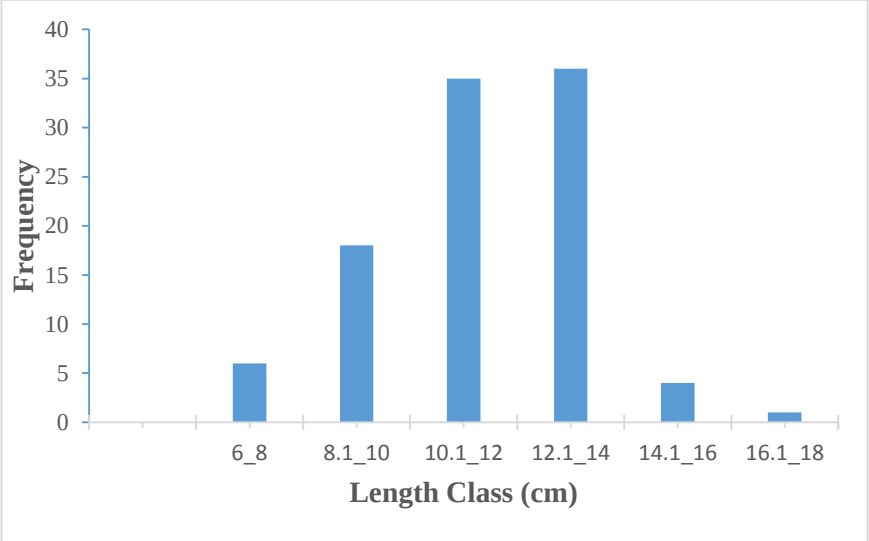


**Fig.1.** Length classes frequency of *Alburnus sellal* in the Little Zab River.

accuracy of 0.01g, the specimens were dissected. Then the gut weight (g) and length (mm) were measured and recorded. Gastrointestinal components were also examined to evaluate the feeding parameters of stomach fullness and contents. The condition factor was calculated from the equation: $CF= W/TL^3 \times 100$ where W= Body weight (g), TL= total length (cm) (Biswas 1993).

The relative length of the gut was calculated using the equation of RLG= Li/L, where Li= length of the gut (cm) and L= total length (cm) (Hyslop 1980). The relative length of the gut is associated with the type of food eaten. If RLG= 1 shows omnivore feeding habit, RLG<1 carnivore, and RLG>1 herbivore. This index is a general one that should be confirmed by examination of the digestive system contents. The gastrointestinal vacuity index was calculated using the equation of VI= (ES/TS)×100, where ES= number of empty stomachs and TS= total number of stomachs examined (Biswas 1993). The index is interpreted as follows: If 0≤VI<20 aquatic system where fish inhabit is rich in food, if 20<VI≤ 40 aquatic food is relatively nutritious, if 40<VI≤ 60 aquatic medium has a moderate nutritional value, if 60<VI≤ 80 shows that aquatic food is relatively low in nutrition, and if 80<VI≤ 100 is a logical consequence of this it is aquatic system has low nutrition.

The Gastrosomatic index was calculated using the equation of GI= Wi/W, where Wi= Weight of the Gastrointestine (g) and W= Total body weight (g) (Hyslop 1980). Data were analyzed using SPSS19 statistical software. One-way ANOVA was used to compare the average of variables in different months. When differences were significant at a 95% confidence limit, Duncan's test was used to determine the significance among different months. Charts were produced in Excel 2019.

## RESULTS

In total, 44 female and 51 male specimens were caught. The male's total length ranged from 6.76 to 16.18cm (10.80±2.02) and of females 7.78-15.17cm (12.00±1.66). The range of weight of male and female fish was 2.7-34.3g (11.95±6.88) and 4.1-35.00g (15.55±7.02), respectively (Table 1). The dominant male and female length class was 12.1-14 cm (Fig. 1).

Iran. J. Ichthyol. (2023) 10(4): 207-214

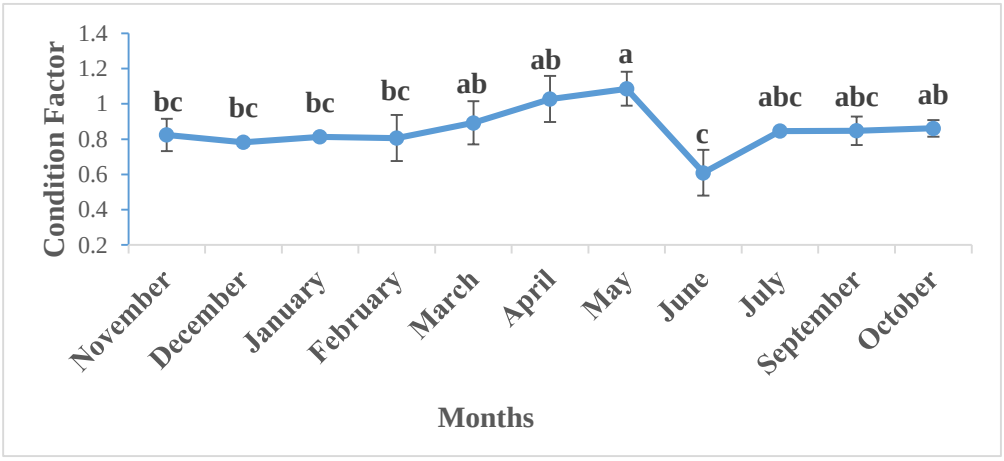


**Fig.2.** Average condition factor of male *Alburnus sellal* in different months in the Little Zab River.

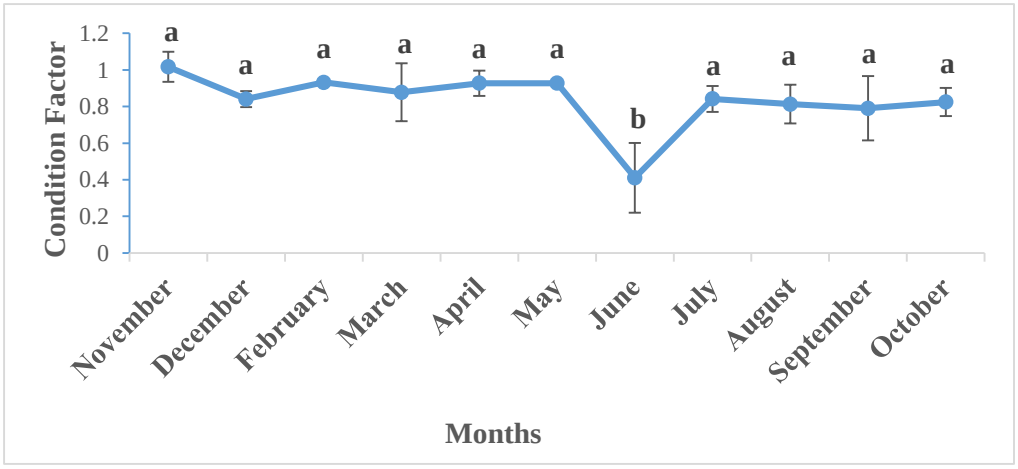


**Fig.3.** Average condition factor of female *Alburnus sellal* in different months in the Little Zab River.

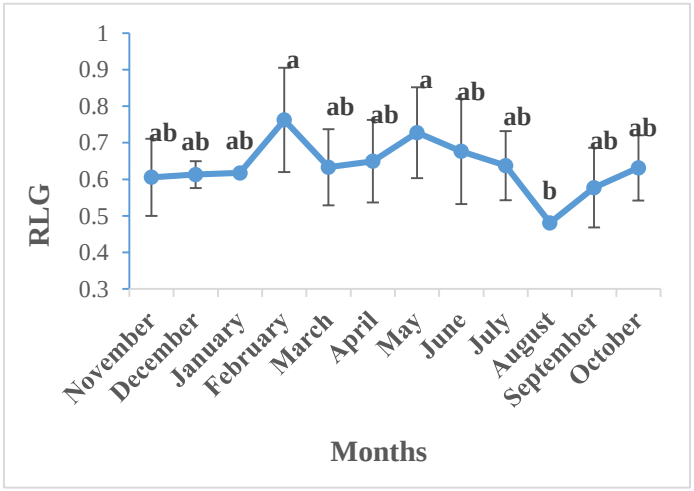


**Fig.4.** Monthly changes in relative length gut of *Alburnus sellal* in different months in the Little Zab River.

The average condition factor of females and males during different months showed a significant difference ($P$<0.05) (Figs. 2-3). But there was no significant difference between males and females. The mean of the condition factor in males and females was 0.85.

The average RLG was obtained for all specimens as 0.65±0.11 which indicates *A. sellal* as a carnivore fish, but the observed items in the gut of examined specimens were mainly aquatic insects, algae, diatoms, and organic decay material. Also, the comparison of the mean of this index in different months showed significant differences amongst them ($P$<0.05) (Fig. 4). There was also no significant difference between the age groups in terms of RLG, the least of which was 0.61 at age 0 (Fig. 5). The highest value of GI in all fish was recorded in January (0.06) and the lowest in August (0.02) (Fig. 6). The mean gastrointestinal vacuity index for all specimens was calculated as 34.34 showing that this fish species has moderate feeding.

The gastrointestinal vacuity index was calculated

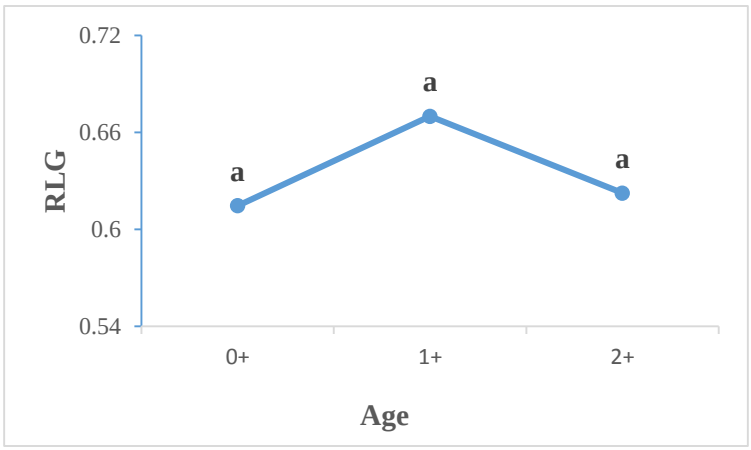


**Fig.5.** Intestinal relative length index, by age group of *Alburnus sellal* in different ages in the Little Zab River.

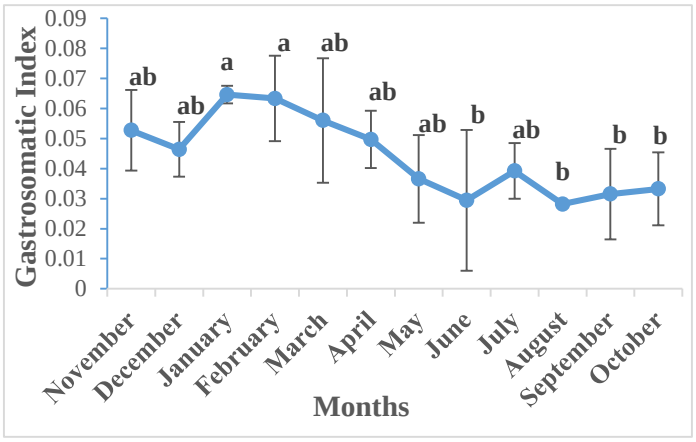


**Fig.6.** Monthly changes in the Gastrosomatic index of *Alburnus sellal* in different months in the Little Zab River.

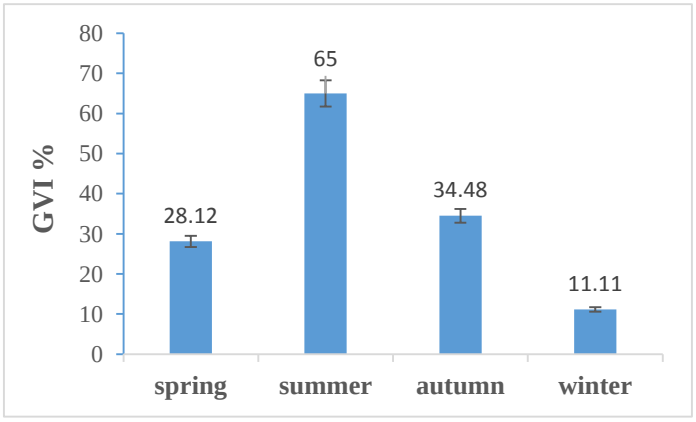


**Fig.7.** Season changes in the gastrointestinal vacuity index of *Alburnus sellal* in different season in the Little Zab River.

for different seasons (Fig. 7). The monthly changes in this index are shown in Figure 8. Of the 95 stomachs examined, 34 were empty stomachs, 39 were full stomachs, and 22 semi-full stomachs. Comparison of mean values of Gastrosomatic index (GI) for male and female fish and all fish in different months showed

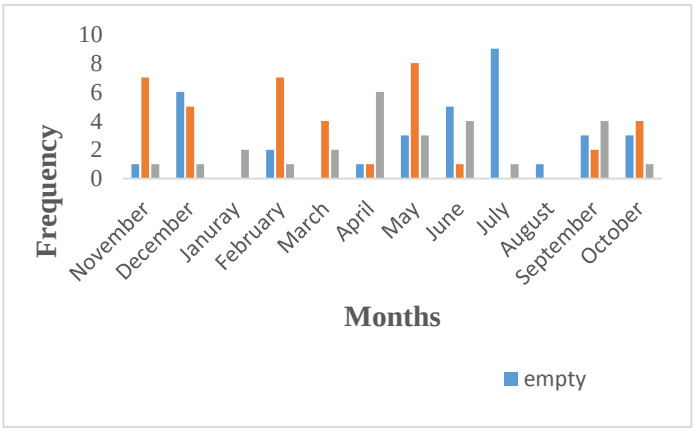


**Fig.8.** Frequency percentage of full, empty, and semi-full stomachs of *Alburnus sellal* in different months in the Little Zab River.

significant differences ($P<0.05$).

## DISCUSSION

Understanding fish nutrition habits requires extensive field and laboratory works to infer the main sources of nutrition (Valinassab et al. 2011). Studies of fish diet, feeding ecology, and food habits are carried commonly out through dissection and examination of gut contents (Braga et al. 2012). Feeding is the dominant activity of the entire life cycle of fish (Joadder & Hossain 2008). *Alburnus sellal* was described from the Queiq River in Aleppo, Syria. It is a wide-ranging species found in the Euphrates-Tigris system eastwards to the Kor, Persis, and Hormuz basins of south-central Iran (Eagderi et al. 2019). Two species of *A. selcuklui* from the Botan basin, a tributary to the upper Tigris in Turkey, and *A. zagrosensis* from the Karun basin, a tributary to the

lower Tigris in Iran, were recently added to the long synonymy of *A. sellal* (Eagderi et al. 2019; Cicek et al. 2021). Therefore, such a widely distributed species exhibits a high degree of phenotypic plasticity across different habitats as well as high variation in their feeding habits as inferred from their gill rakers in previous studies *(Cicek et al. 2021)*. A high number of gill rakers reflects a diet dominated by zooplankton and other pelagic prey, whereas fishes with a lower number of gill rakers mainly feed on zoobenthos (Bernatchez et al., 1999; Amundsen et al., 2004). Therefore, one might expect similar eco-evolutionary interactions to create and maintain divergence in gill-raker morphology between lotic and lentic populations of *A. sellal showing* different feeding habits based on their habitats *(Cicek et al. 2021*). Hence, the study of the feeding of such a widely distributed fish species can help to know the changes in the ecosystem productivity.

In this study, the length of the females was higher than that of the males, and the females had a higher length in numerical terms. The observed average total length and body weight of *A. sellal* were 12.00±1.66cm and 15.55±7.02g for females and 10.80±2.02cm and 11.95±6.88g for males, respectively. In general, the difference in the length of the fish can be due to differences in the fishing season, different geographic areas, biological and ecological conditions, or inter-species and in-species differences in different regions (Froese 2006).

Based on the results, the mean of condition factor changes in both males and females showed a significant difference in different months, but there was no significant difference between males and females. The mean of the condition factor in males and females was 0.85 showing the Little Zab River as a moderate waterbody for *A. sellal* (Zamani Faradonbe et al. 2015). Keivany et al. (2017) found no significant differences between males and females during different months and also no significant difference among the months in both sexes of *A. sellal* in the Bibi-Sayyedan River, Isfahan basin. The mean condition factors were 0.85±0.15 and 0.86±0.17 in females and males, respectively. Innal & Gulle (2019) studied the growth characteristics of *A. baliki* in the Manavgat River Estuary, Turkey and they reported condition factor values of 0.77 ranging from 0.52 to 1.20. The condition factor as an indicator of growth and nutrition intensity is used to compare fitness and fish health (Seher & Suleyman 2012). Condition factor is an important biological parameter, which indicates the suitability of a specific water body for the growth of fish and an index of species average size (Alam et al. 2014). The values of this factor depend on the physiological features of fish especially maturity, spawning, life cycle, environmental factors, and food availability in a water body (Ujjania et al. 2012; Asadi et al. 2017).

According to the results, the vacuity index of females and males showed no significant difference in different seasons during the year and in all seasons. In addition, the value of this index was different between males and females in different seasons. High values of the vacuity index in both sexes can be related to daily feeding cycles, prey availability, and reproductive activity of predator species (Jorfipour et al. 2022). Comparison of the gastrosomatic index between males and females showed no significant difference during the year. The maximum GI in this study was observed for males at 0.071 and females at 0.091. The monthly comparison of the gastrosomatic index showed that there is a significant difference between different months.

Based on the current study, RLG for *A. sellal* was 0.65±0.11. According to the value of 0.65 and the gastrointestinal material, it is concluded that it is an omnivorous species (Mohammadzadeh et al., 2016). In examining the feeding pattern, *A. sellal* feeds from a variety of aquatic plants, algae, and insects. Also, in a study on the feeding ecology of *A. chalcoides* in the Sefid River, Caspian Sea basin, Chlorophyta and Cyanophyta and two zooplankton orders of Copepoda and Cladocera were the major food items (Rajabi Nezhad & Azari Takami 2009). According to the results of the Gastrosomatic index and Gastrointestinal vacuity index, *A. sellal* feeds on Little Zab River throughout the year and the feeding intensity of this species fluctuates throughout the year,

with a significant increase in January and February. The reason for the high feeding intensity in these two months is probably related to the need for fish to supply more energy for developing gonads to complete the reproductive and spawning processes because these two months in accordance before the spawning season this species is in the Little Zab River.

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**مقاله کامل**

# شاخص‌های تغذیه‌ای ماهی *Alburnus sellal* در رودخانه زاب کوچک، غرب ایران

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**چکیده:** ویژگی‌های تغذیه ماهی *Alburnus sellal* در رودخانه زاب‌کوچک، استان آذربایجان غربی، ایران از آبان ۱۴۰۰ تا مهر ۱۴۰۱ مورد مطالعه قرار گرفت. نمونه‌های جمع‌آوری شده در پودر گل میخک ۱٪ بیهوش شده و در فرمالین ۱۰٪ تثبیت و به آزمایشگاه منتقل شدند. میانگین فاکتور وضعیت برای جنس نر و ماده ۰/۸۵ بود و اختلاف معنی‌داری را بین ماه‌های مختلف در دو جنس نشان داد ($P$<۰/۰۵). میانگین طول و وزن برای کل نمونه‌ها به‌ترتیب ۱/۹۵±۱۱/۳۶ سانتی‌متر و ۷/۱۴±۱۱/۸ گرم بود. میانگین طول روده برای کل ماهیان در طول سال ۰/۱۱±۰/۶۵ بود. میانگین طول روده (RLG) در ماه‌های مختلف تفاوت معنی‌داری نشان داد ($P$<۰/۰۵). بیشترین مقدار شاخص معدی-بدنی GI در دی ماه و کمترین آن در مرداد ثبت شد و در ماه‌های مختلف تفاوت معنی‌داری نشان داد ($P$<۰/۰۵). در مجموع ۳۴ معده خالی در بین ۱۰۱ نمونه ماهی مشاهده شد که در ماه‌های مختلف تفاوت معنی‌داری نشان داد ($P$<۰/۰۵). این گونه یک ماهی همه‌چیزخوار است که عمدتاً حشرات آبزی، گیاهان آبزی، جلبک‌ها، دیاتومه‌ها و مواد آلی با تغذیه متوسط در سال را دارد.

**کلمات‌کلیدی:** طول نسبی روده، شاخص خالی بودن معده، تغذیه، فاکتور وضعیت.