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Study of the Environmental Factors Affecting the Abundance of the Asian Catfish H.1843 Silurus triostegus in the Hammar Marsh

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Abstract

Fish are among the most important organisms in aquatic ecosystems due to their nutritional, economic, and environmental value. This study focused on the impact of environmental factors—including temperature, salinity, pH, and dissolved oxygen—on the feeding behavior of the Asian catfish (Silurus triostegus) in the Al-Hammar Marsh, Dhi Qar Province, southern Iraq.A total of 60 fish samples were collected over a six-month period (October 2024 to March 2025), with 10 samples per month. Stomach contents were analyzed using the point method. The results showed the highest feeding activity occurred in October and November, where most stomachs were full or half-full (scores of 20 or 10). In contrast, December and January recorded the highest percentage of empty stomachs (score 0), reflecting reduced feeding activity likely due to environmental fluctuations.Biochemical analyses revealed a decrease in protein and fat content in muscle tissues from the beginning to the end of the study: protein decreased from 19% to 16.7%, and fat from 0.13% to 0.07%. Moisture content increased from 76.4% to 80.04%, and ash content from 1.01% to 1.24%. Similar patterns were observed in liver tissues, where protein dropped from 17.6% to 14.18%, and moisture increased from 71.86% to 73.7%.These findings demonstrate that environmental factors directly influence the feeding patterns and nutritional condition of Asian catfish. The study highlights the importance of monitoring aquatic environmental conditions to support fish health, growth, and sustainable fishery management.

Keywords: Fish, Asian catfish (Silurus triostegus), Hammar Marsh, environmental factors, nutrition, protein, salinity, pH, dissolved oxygen.

I. Introduction

Iraq is characterized by possessing a wide aquatic area estimated at 4.4 million dunams. Wetlands contribute to improving environmental conditions and serve as vital habitats for fish and water birds. Their system—composed of rivers, marshes, and lakes—forms an ideal environment for the nursery and feeding of fish larvae and other organisms (Abdalhsam et al., 2020). Fish are known for their sensitivity to environmental changes, particularly the increase in heavy metal concentrations (Adeel et al., 2019).

The Hammar Marsh is one of the most prominent Mesopotamian wetlands in terms of biodiversity. It is divided into two parts by an earthen embankment: the western part lies within Dhi Qar Province, covering an area of 1,326 km², stretching from near Nasiriyah city to the northwest of Basra Province, and is fed by several rivers. The eastern part lies within Basra Province, fed by the Shatt al-Arab River and affected by tidal movements (Dhaidan et al., 2021).

Aquatic organisms are classified into fish, mollusks, crustaceans, and other species, some of which are suitable for human consumption according to the U.S. Food and Drug Administration classifications (Farzad, 2022). In 2016, global fish production reached approximately 171 million tons (FAO, 2018).

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Several non-native fish species were introduced into the Iraqi marshes since the 1970s to enhance inland fisheries. These include common carp, Calisa, red and blue tilapia, as well as species such as Gambusia, Asian catfish, and stingrays, for mosquito and malaria control. These species have widely spread in southern Iraq, with Asian catfish reaching parts of the Euphrates River such as Haditha in Anbar and the Tigris River as far as Samarra (Al-Dubaikel, 1986). The Asian catfish is considered an economically important species in some countries, especially Turkey, and is abundant in Southeast Asia.

The abundance and distribution of fish are influenced by multiple interacting environmental factors. The response to these factors varies by species, making it difficult to attribute the presence of a particular species to a single factor (Al-Sayab, 1989). Environmental factors include the physical and chemical properties of water, which affect fish activity, growth, feeding, reproduction, and behavior (Ribeiro, 1995).

Studies indicate that environmental factors such as salinity and temperature directly affect the structure of fish communities, alongside depth and light penetration, which in turn influence water temperature (Al-Zireg, 2019). Other research shows that increased salinity leads to reduced species abundance, especially with decreasing freshwater discharge and rising temperatures due to climate change (Al-Jboor and Hussain, 2024). Moreover, increased pollution and turbidity reduce biomass, disrupt food chains, decrease functional diversity, and intensify interspecies competition (Al-Jboor and Hussain, 2024).

Factors Affecting the Abundance of Asian Catfish in the Hammar Marsh

Water Temperature

It plays a vital role in determining fish abundance, influencing metabolism, feeding activity, and seasonal migration. Asian catfish abundance is typically observed in spring and summer (Al-Zireg, 2019).

pH Level

Fish maintain physiological balance within a specific pH range. Significant deviations lead to decreased density or migration from the area (Al-Saadi, 2020).

Dissolved Oxygen (DO)

Essential for fish survival; low oxygen levels harm sensitive species like Asian catfish (Mohamed, 2017).

Aquatic Plants

They provide suitable environments for reproduction and protection from predators, increasing fish density in areas with dense vegetation (Yousif and Al-Zubaidi, 2019).

Studies show that the abundance of Asian catfish is positively correlated with high water temperatures, availability of aquatic vegetation, and high dissolved oxygen levels. In contrast, changes in pH and water pollution lead to population declines (Salim and Alwan, 2021). Notably, significant populations of Asian catfish have been recorded in specific areas of the Hammar Marsh, with dissolved oxygen concentration identified as the primary determining factor (Yousif and Al-Zubaidi, 2019).

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II. Materials and Methods

Study Area Description

The study was conducted in Dhi Qar Province, specifically in the Hammar Marsh, which is one of the largest water bodies in the Middle East and the largest marshland in Iraq by area. This marsh is located south of the Euphrates River and stretches from the city of Suq Al-Shuyukh (Dhi Qar Governorate) in the west to the outskirts of Basra near the Shatt Al-Arab in the east (Basra Marshes Site, 2007). The Hammar Marsh lies between latitudes 30°–31.40° N and longitudes 30.46°–40.47° E. It extends from the city of Nasiriyah in the west to the fringes of Basra in the east. The marsh covers an area ranging from approximately 2,800 to 4,500 km² during flood seasons, with water depths varying from 1.8 meters in some areas to 5 meters in others.

The Hammar Marsh is primarily fed by the Euphrates River, with minor contributions from the Tigris River (UNEP, 2006). In early 2003, as part of restoration efforts, a portion of the marsh was reflooded and named the East Hammar Marsh. It was classified as one of the largest southern Iraqi wetlands, with its longitudinal axis extending from Al-Hammar subdistrict to the Karmat Ali outlet, measuring about 123 km in length and 26 to 35 km in width (UNEP, 2006; Al-Mansouri, 2008). The East Hammar Marsh is affected by semi-diurnal tidal movements and has brackish water. The tidal fluctuations significantly influence the basic properties of marsh water. It is home to both freshwater and migratory marine fish, marine shrimp, various gull species, and large populations of waterfowl (Hussain, 2014).

2.2 Sample Collection

Samples were collected from the Al-Jweiber area of the Hammar Marsh, with 10 samples taken monthly over a period of six months, totaling 60 samples. The sampling period extended from October 2024 to March 2025. Fish were randomly collected and placed in containers filled with crushed ice for transport to the laboratory. Specimens were identified and dissected on the same day, following the method of Al-Daham (1997). Total length and weight were measured for each fish of both sexes.

Each fish was dissected to extract the stomach, and the diet was analyzed using the volumetric, gravimetric, and point methods (Hynes, 1950). Environmental parameters were also measured monthly, including pH, salinity (EC), temperature (°C), and dissolved oxygen (DO).

Water Temperature

Figure (1) shows the variation in water temperature. The lowest recorded temperature was 15.5°C in February, while the highest was 27.9°C in October. This variation is attributed to the direct relationship between water and air temperatures (Nasser, 2022). Water temperatures are typically lower in the early morning and gradually increase toward midday. Flow velocity may also cause temperature fluctuations due to the mixing and homogenization of water from the bottom to the surface (Al-Abadi, 2015).

pH (Hydrogen Ion Concentration)

Figure (1) shows that pH values ranged from 8.52 to 8.53, with slight variations during the sampling period from October to March. These findings are consistent with previous studies conducted in Iraqi waters (Abu Al-Hani, 2014; Al-Kanani, 2015; Nasser, 2022; Al-Abadi, 2022). Generally, pH levels tend to increase when water discharge is low (Sabri et al., 1989). A high density of phytoplankton also raises pH levels due to intensified photosynthesis, which leads to increased consumption of carbon dioxide (CO_2) and subsequently raises pH (Goldman & Horne, 1983). During colder months, low discharge can also result in higher pH levels (Sabri et al., 1989). On the other hand, lower pH values during warmer months may be due to increased CO_2 concentrations resulting from the decomposition of organic matter by decomposer

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organisms, whose activity increases with higher temperatures, as well as from increased respiration by aquatic plants and animals (Brown, 1980).

Dissolved Oxygen (DO)

The results in Table (1) indicate that dissolved oxygen levels ranged from 6.13 to 9.2 mg/L during the study period from October to March. These findings are similar to those of Nasser (2022), who recorded DO values between 6.99 and 8.9 mg/L. The results are also consistent with those of Al-Shukrji (2022), who reported values ranging from 5.6 to 8.13 mg/L. The increase in dissolved oxygen levels in February is likely due to the reduced biological activity and continuous water movement. The decline in DO levels in November could be attributed to the scarcity of aquatic plants, increased organic waste, or slow water movement—similar to findings by Al-Zaidi (2020) and Al-Maramdhi (2021). Overall, DO values were relatively high throughout the study period.

Total Dissolved Solids (TDS)

Figure (2) indicates that the highest TDS value was 21,350 mg/L in December. This supports the general correlation between TDS and electrical conductivity in water, consistent with findings by Al-Sharifi (2014), Hanaf (2016), The lowest TDS value was 8,150 mg/L in January, likely due to lower temperatures, seasonal changes, and reduced electrical conductivity (Hanaf, 2022).

Table (1): Measurements of Environmental Parameters

month	Temperature (°C)	Salinity (mg/L)	PH	Dissolved oxygen (ppm)	Total dissolved solids (ppm)
October	27.9	2.29	8.27	6.61	19840
November	23.9	2.41	8.28	6.13	20790
December	18.2	2.46	8.12	7.16	21350
January	16.5	0.94	8.5	8.4	8150
February	15.5	1.39	8.3	9.2	12050
March	16.1	1.21	8.52	8.44	10466

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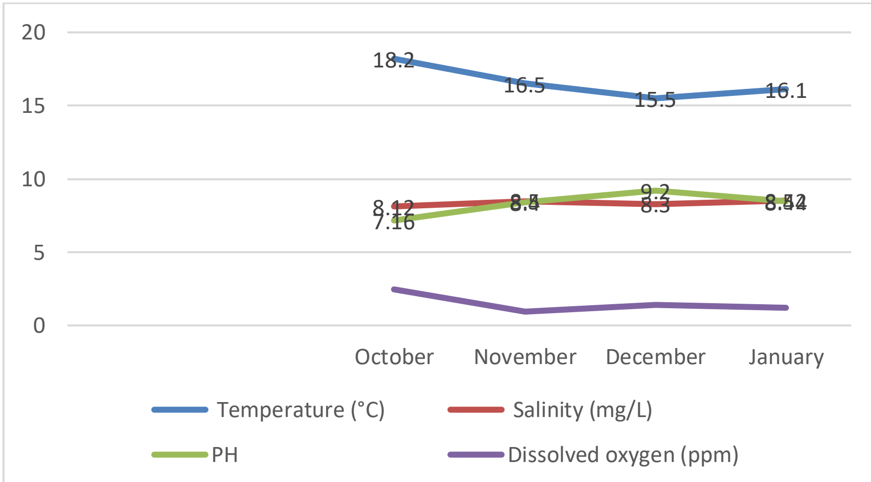

Figure (1): Water Properties

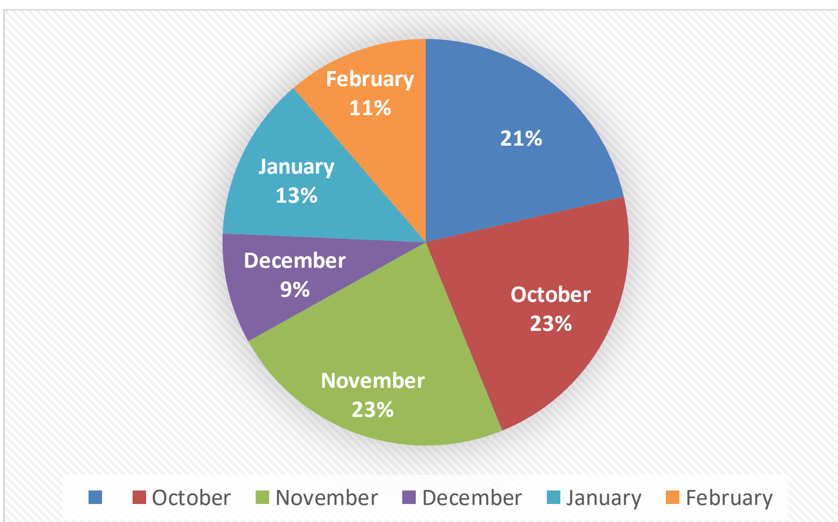

Figure (2) Total dissolved solids (ppm)

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Table (2) Number of Males, Females, and Unidentified Individuals per Month

month	The number of males	The number of females	indistinctive
October	4	6	0
November	4	4	2
December	1	9	0
January	4	6	0
February	3	7	0
March	6	2	2

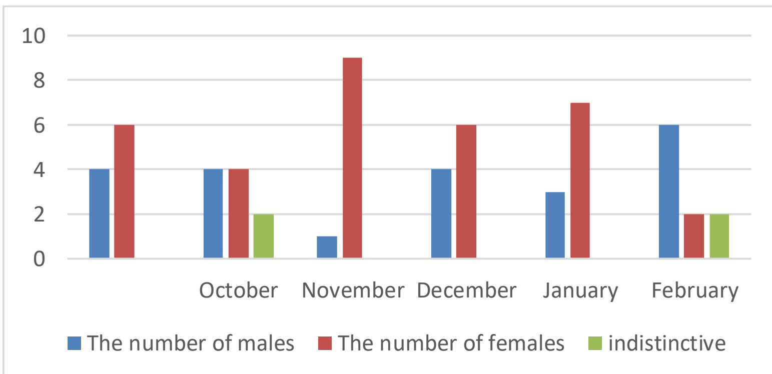

Table (3): Effect of Study Months on Some Growth Parameters of Asian Catfish

(Mean ± Standard Error)

Attributes / Month	Body weight (g)	Body length (cm)	Gonad weight (g)	Liver weight (g)
number	10	10	10	10
October	±90.640 362.600b	±25.567 354.100bc	±2.325 4.398b	±0.689 2.550d
November	±37.994 303.000b	±17.403 340.500c	±0.760 2.380b	±0.644 3.157d
December	397.800 ±57.792ab	±14.557 381.300abc	±5.627 27.640a	±0.951 6.655bc
January	±60.550 561.200a	±22.535 422.600a	16.423 ±9.696ab	±1.577 9.551a
February	±44.353 345.000b	±13.223 364.700bc	16.342 ±6.130ab	±0.393 4.098dc
March	±81.516 574.000a	±20.952 403.400ab	±2.068 4.315b	7.0140 ±1.139ab
Morale	P≤0.01	P≤0.05	P≤0.01	P≤0.01

$P \le 0.05$: Significant
$P \le 0.01$: Highly significant
Different letters within the same column indicate significant differences

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Table (4): Effect of Fish Gender on Some Growth Parameters of Asian Catfish(Mean ± Standard Error)

Attributes / Sex	Body weight (g)	Body length (cm)	Gonad weight (g)	Liver weight (g)
number	10	10	10	10
male	±44.584 363.227	±14.010 351.272	±0.820 2.677b	±0.890 4.533
female	±39.737 465.617	±10.596 396.647	±3.768 19.296a	±0.629 6.279
indistinctive	±95.597 403.500	±27.395 363.000	0b	±1.262 4.250
Morale	NS	NS	P≤0.01	NS

P ≤ 0.01: Highly significant
NS: Not significant
Different letters within the same column indicate significant differences

Table (5): Effect of Fish Gender on Condition Factor and Gonadosomatic and Hepatosomatic Indices in Asian Catfish

Attributes	temperature	Salinity	PH	Dissolved oxygen	Total dissolved solids
temperature	-	0.71009 NS	-0.38629 NS	-0.85302 *	0.70821 NS
Salinity		-	-0.85979 *	-0.85989 *	0.99998 **
PH			-	0.51590 *	-0.86207 *
Dissolved oxygen				-	-0.85779 *
Total dissolved solids					-

(Mean ± Standard Error)

Attributes / Sex	Physical status laboratories	Sexual function	Liver
number	10	10	10
male	±0.00003 0.00076	±22.832 23.525	±0.101 1.126
female	±0.00002 0.00066	±0.826 4.344	±0.119 1.444
indistinctive	±0.00007 0.00078	0	±0.208 1.053
Morale	NS	NS	NS

NS :Not significant

Table (13): Simple Correlation Coefficients Between Physical Water Parameters During the Experiment Period

Not significant (NS) P ≤ 0.05: * (significant) P ≤ 0.01: ** (highly significant)

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4. Conclusion

The collections of this study showed that the surrounding factors such as temperature, salinity, pH, and dissolved oxygen have a direct and clear impact on the abundance of Asian running fish * Silurus triostegus * and in its dietary activity inside the ass. It was found that the highest nutrition rates were recorded during the months of October and November, while it decreased clearly in the months of December and the second, and this is related to quarterly changes in environmental conditions. Biochemical analyzes also showed a gradual decrease in protein and fat content in muscle and liver tissue over the passage of the study period, compared to a rise in the content of moisture and ash, which reflects the impact of the nutritional state of fish by environmental shifts. These results emphasize the importance of permanent monitoring of the physical and chemical properties of water in order to maintain the health of the fish stock and ensure the sustainability of fisheries, with the need to apply effective environmental management strategies to take over the quarterly changes and limit the negative effects of environmental factors on important economic species.

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