Al-Muthanna J. For Agric Sci Online ISSN:2572-5149
Print ISSN: 2226-4086
Vol. 12 , Issue 2. 2025

https://muthjas.mu.edu.iq/ http://doi.org/10.52113/mjas04/12.2/58

The relationship between bi-monthly infections, parasitic infections, and environmental factors in the breeding system in Babylon Governorate, Iraq.

Zaid S.S. Awad and Ammar M.S. Al-Hilli

College of Agriculture, Al-Muthanna University, Iraq.

Abstract:

The parasitic animal group on grass carp (*Ctenopharyngodon idella*) fingerlings, was studied, in two different fish farming systems: earth-based clay ponds and floating cages. This study aimed to investigate the relationship between bimonthly infestations, parasite infestation, and environmental factors within the fish farming system in Babylon Governorate, Iraq. The study was conducted during the months of October, November, and December 2025, with two samples collected per month at the two study stations: the Euphrates Fish Farm and the Engineer Abbas Cages. The study included measuring several environmental factors, namely water temperature, salinity, pH, and dissolved oxygen. The average water temperature in the pond and cage systems was recorded at 22.11 and 21.11°C, respectively, while the average salinity was 0.62 and 0.60°C. The average pH was 7.31 and 7.05, respectively. The average dissolved oxygen was 6.48 and 8.48, respectively. The results showed a significant difference between the two rearing systems at a significance level of ($P \leq 0.01$). The only exception was pH, which showed a significant difference at a significance level of ($P \geq 0.05$).

Keywords: bi-monthly infections, parasitic infections, environmental factors, breeding system, Babylon Governorate.

Introduction:

Grass carp are characterized by a diet that relies heavily on aquatic plants, hence the name "grass fish" or "grass carp" to distinguish them from other fish species. Their feeding habits can determine their standard of living based on the availability of aquatic plants in the environment (Bozkurt *et al*., 2017).

In their early stages, fingerlings rely on small zooplankton, because these are easily digestible and small in size. As they mature, they gradually switch to feeding on phytoplankton and algae. Upon reaching maturity, they depend primarily on aquatic plants. This dietary shift contributes to the development of their immune system. However, relying on plankton in their early stages, may lead to the introduction of early stages of parasites into the body (Prati *et al*., 2020).

Parasitic infections are linked to multiple environmental factors. Fish depend on a suitable environment for their feeding habits. The absence of any environmental factor directly or indirectly affects fish health and increases infection rates. Management factors, particularly fish density, also play a significant role (Ruben et *al*., 2025).

During the hatching stage, fish are found in very large numbers within a small area. Then, during the outdoor nursery stage, the density reaches approximately one million larvae per dunam. This decreases during the development stage, reaching around 50,000 fingerlings per dunam in outdoor ponds. The development stage is considered one of the most important stages, during which the environment must be clean, sterile, and free of parasites (AL-Hilali *et al*., 2024).

Therefore, the survival rate is relatively low (around 20%) due to predation, weak immunity, or inadequate pond preparation. During the development stage, supplemental feeds such as soybean meal and fishmeal can be used. However, during the rearing stage, feeding and fish stocking vary depending on the system. Studies have shown that young fish are more susceptible to external parasites than adult fish. It has also been concluded that young fish are more prone to external parasites. Conversely, adult fish are more susceptible to external parasites. This is due to their weak immunity and thin skin and gills, which facilitates parasite penetration, while adult fish may carry parasites without showing obvious symptoms (Tanika *et al*., 2022).

Environmental factors play a significant role in increasing infestation. High temperatures lead to increased parasite activity, accelerating their life cycle and spread. Conversely, low temperatures reduce parasite activity. This weakens immunity and reduces food intake, especially in fingerlings. Dissolved oxygen levels below the optimal level (5 mg/L), causes stress in fish, reduces their immunity, and increases infestation. It also leads to gill damage and increased infestation by parasites such as *Dactylogyrus* (Salgado-Moreno *et al*., 2025).

Regarding salinity, its decrease makes fish more susceptible to parasites. It also affects the aquatic environment by reducing phytoplankton. This leads to stress in the fish and weakened immunity. Stagnant water in ponds, the accumulation of organic matter, and low oxygen levels, lead to increased parasite infestations. Therefore, good management and continuous monitoring of environmental factors are necessary. In

cages, although there is running water, the high density and difficulty in controlling infections, lead to the rapid spread of parasites (Carbonara *et al*., 2026).

Grass carp are characterized by their rapid growth. However, this growth rate is affected by environmental factors, especially water temperature, which also influences parasite growth and spread. Therefore, poor management and high stocking densities lead to increased infestation and reduced fish health (Wu *et al*., 2026).

This study aims to investigate the relationship between bimonthly infections, parasitic infections, and environmental factors in the breeding system in Babylon Governorate, Iraq.

Materials and Methods:

The field work included measuring some environmental factors of the water and catching fingerlings for three months, on a half-monthly basis (from the beginning of October until the end of December 2025). The date for taking the samples was set for the first day of each half-month, twice a month at eight in the morning.

The water temperature was measured using an electronic field thermometer integrated with an EC meter for measuring salinity of Chinese origin, by immersing the device's electrode for one minute to stabilize the reading and record it.

The salinity was measured using a field (EC meter) of Chinese origin, which can measure total dissolved solids (TDS). The device's electrode is immersed in water, and the reading is taken after one minute. The salinity is calculated in parts per thousand (gm. L).

pH was measured semi-monthly for three months using a field pH meter of Chinese origin, where the device's electrode is immersed in water and the reading is taken after one minute.

Dissolved oxygen was measured using an American-made (YSI) device, in mg.L, where the device's electrode is immersed in water and the reading is taken after one minute to stabilize the reading and be more accurate. The fingerlings were caught using fine-mesh nets in the ponds and hand nets for the fingerling specimens in the cages. The live fingerlings were then transported to the laboratory for disease and parasite testing using large polyethylene bags. One-third of the bag was filled with water containing the fingerlings. The remaining two-thirds were filled with air and sealed tightly. This process continued until the fingerlings reached the laboratory of the College of Agriculture, Department of Animal Production, Al-Qasim Green University in Babylon Governorate.

Upon arrival at the laboratory, the fingerlings are placed in two separate glass tanks measuring 60×30×40 cm. Each tank is equipped with a ventilation device. First, the fingerlings are immobilized by severing their spinal cords with a needle near the head using a pithing procedure. The information is recorded on a form, including the sample number, the date of sample examination, the location of the infestation, the breeding method, weight, length, parasite type, and the number of parasites in each sample.

Results and Discussion:

Relationship between Bimonthly Infections and Parasite Infections and Environmental Factors in Ponds

The correlation results in the pond rearing system were notable. The parasite *T. nigra* showed a strong negative correlation with temperature (-0.819), while it had a positive correlation with dissolved oxygen, salinity, and pH. Similarly, the parasite *T. streilkovi* showed a negative correlation with temperature (-0.883) and positive correlations with the remaining environmental factors. The parasite *T. domeguei* showed a moderately strong negative correlation with temperature (-0.517) and weak positive correlations with oxygen, salinity, and pH. Ciliates also showed a strong negative correlation with temperature (-0.854). Ciliates and flatworms showed strong negative correlations with oxygen, salinity, and pH, ranging from -0.866 to -0.959. Tapeworms, on the other hand, showed very high correlations with all environmental factors. The correlation coefficient was negative with temperature, dissolved oxygen, and salinity, while it was positive with pH. This indicates their direct and clear susceptibility to environmental changes (Table 1).

Table (1) Correlation of bi-weekly infestations with parasite infestations and environmental factors in ponds.

Parasite	Environmental factors			
	Temperature	**Dissolved oxygen**	**Salinity**	**pH**
T. nigra	-0.819-	0.0000	0.7490	0.7240
T. streilkovi	-0.883-	0.2540	0.8330	.8220
T. domeguei	-0.517-	0.8700	0.0350	0.201
Ciliates	-0.854-	0.8650	0.5410	0.4860
Mosquitoes	.9060	-0.866-	-0.948-	-0.959-
Flatworms	.9060	-0.866-	-0.948-	-0.959-
Tapeworms	1.000	-1.000-	-1.000-	-1.000-

The negative relationship with temperature for parasites such as *T. nigra*, *T. streilkovi*, and ciliates, was often linked to the parasite's life cycle. At low temperatures, the metabolic rates of fish (hosts) may decrease, weakening their immune response and making them more susceptible to infection. On the other hand, certain parasite species may prefer temperate or cool temperature ranges for reproduction, while high

temperatures accelerate the decomposition or death of the parasite's free-living larval stages in the water (Tomamichel *et al*., 2025).

Regarding the positive correlation with oxygen, salinity, and pH, positive correlations indicate that these parasites thrive and proliferate more in water with stable or slightly elevated chemical properties of these factors. A suitable pH enhances the parasite's ability to adhere to the host or penetrate the skin/gills (Zhou *et al*., 2022).

While molluscs, flatworms, and tapeworms show an inverse correlation with chemical factors, these organisms are often more sensitive to changes in water quality, such as salinity and pH. The strong negative correlation suggests that they may create a "stressful" environment for fish under certain conditions, such as low oxygen levels, where poor host health leads to increased parasite load (infestation intensity) (Grabner *et al*., 2023).

Correlation of Bimonthly Parasitic Infections with Environmental Factors in Cages:

In the cage system, the results showed that the parasite *T. nigra* exhibited a strong negative correlation with oxygen (-0.962) and salinity (-0.993), and a positive correlation with pH (0.970). *T. streilkovi* showed a complete correlation with all environmental factors, with correlation values of (+1) with temperature and pH, and (-1) with oxygen and salinity. This indicates the sensitivity of this parasite to environmental changes in cages. *T. domeguei* showed a moderate negative correlation with oxygen (-0.624) and a strong negative correlation with salinity (-0.851), compared to a positive correlation with pH (0.699). Ciliates also showed a negative correlation with temperature (-0.678). Molluscs and flatworms showed a very strong negative correlation with pH (-0.991), with weak or moderate correlations with the other factors. Tapeworms also exhibited a very high correlation with all environmental factors. The correlation coefficient was (-1) with oxygen, salinity, and pH, and (+1) with temperature. This indicates the significant influence of environmental factors on the spread of this parasite within cage systems (Table 2).

Table (2) Correlation of Bi-weekly Parasite Infections with Environmental Factors in Cages.

Parasite	Environmental factors			
	Temperature	Dissolved oxygen	Salinity	pH
T. nigra	0.9700	-0.993-	-0.962-	.1320
T. streilkovi	1.000	-1.000-	-1.000-	1.000
T. domeguei	0.6990	-0.851-	-0.624-	0.5430
Ciliates	-0.678-	0.820	0.3170	0.6590

Mosquitoes	0.2450	-0.115-	0.2740	-0.991-
Flatworms	0.2450	-0.115-	0.2740	-0.991-
Tapeworms	1.000	-1.000-	-1.000-	-1.000-

Based on the results obtained, the scientific explanation for these correlations, was based on the concept of "environmental tolerance" and "optimal requirements" for each parasite. In the aquatic cage environment, physicochemical variables (temperature, oxygen, salinity, and pH) play a crucial role in regulating the parasite's life cycle, in terms of reproduction rates, survival periods outside the host, and the parasite's ability to infect the host (Atroch *et al*., 2026).

A positive correlation (+1) indicates a strong direct relationship; that is, an increase in the environmental factor directly leads to an increase in the density or severity of the parasite infection. For example, a positive correlation (+1) exists between temperature and *T. streilkovi*. This means that this parasite thrives and reproduces more rapidly as the temperature increases within the studied range (Gordy *et al*., 2020).

A negative correlation (-1) indicates an inverse relationship; that is, a higher value of the environmental factor leads to a sharp decrease in the presence of the parasite. This means that the parasite prefers environments with low values of this factor. For example, a negative correlation with oxygen suggests that some parasites may be better adapted to low-oxygen environments or that they are negatively affected by increased dissolved oxygen concentration (Kitazume *et al*., 2018; Al Salman and Al-Gharawi, 2023).

Environmental sensitivity has been observed in parasites that exhibited extreme correlation values (+1 or -1), such as *T. streilkovi* and tapeworms, which are highly accurate bioindicators. Their appearance or disappearance is inextricably linked to changes in water conditions in fish cages, making them highly sensitive to environmental disturbances. The variation in response, as seen in intermediate correlations, such as *T. domeguei*, indicates that the parasite possesses a broader tolerance range to environmental factors and is not entirely dependent on a single factor for its spread (Jerônimo *et al*., 2022).

References:

Al Salman N.T.S. and J.K.M. Al-Gharawi (2023). The effect of locally extracted and imported aloe vera oil on some productive traits of broilers. Bionatura, 8(Issue): 1–8. https://doi.org/10.21931/RB/2024.09.01.46

AL-Hilali, H.A., A.R. Lozovskiy, H.H. Abbas, L.M. Al-Mamoori (2024). Growth performance of common carp, Cyprinus carpio, fry at different experimental stocking densities in the environmental conditions of central Iraq. Int. J. Aquat. Biol., 12(4): 406-417. : https://doi.org/10.22034/ijab.v12i4.2273

Atroch, F., Rangel, L. F., Ayra-Pardo, C., & Santos, M. J. (2026). Climate Change, Fish and Shellfish, and Parasite Dynamics: A Comprehensive Review. Journal of Marine Science and Engineering, 14(2), 167. https://doi.org/10.3390/jmse14020167

Bozkurt Y, Yavas İ, Gül A, (2017) Importance of Grass Carp (Ctenopharyngodon idella) for Controlling of Aquatic Vegetation. Grasses - Benefits, Diversities and Functional Roles. InTech. Available at: http://dx.doi.org/10.5772/intechopen.69192.

Carbonara, C., Colonna, M. A., Giannico, F., Pozzato, L., Cariglia, M., Faccilongo, N., Tarricone, S., & Ragni, M. (2026). Mussel Mortality Events and Changes in the Mediterranean Sea Ecosystem: An Integrated One Health–One Welfare Analysis. Fishes, 11(3), 190. https://doi.org/10.3390/fishes11030190

Gordy MA, Koprivnikar J, McPhail B, Hanington PC. (2020). Environmental and ecological factors driving trematode parasite community assembly in central Alberta lakes. Int J Parasitol Parasites Wildl., 13:283-291. https://doi.org/10.1016/j.ijppaw.2020.11.008.

Grabner, D., L.E. Rothe and B. Sures (2023). Parasites and Pollutants: Effects of Multiple Stressors on Aquatic Organisms, Environmental Toxicology and Chemistry, Volume 42, Issue 9, 1946–1959, https://doi.org/10.1002/etc.5689

Jerônimo GT, da Cruz MG, Bertaglia EdA, Furtado WE & Martins ML. (2022). Fish parasites can reflect environmental quality in fish farms. Rev Aquac. 2022;14:1558–1571. https://doi.org/10.1111/raq.12662

Kitazume, H., Dayi, M., Tanaka, R., & Kikuchi, T. (2018). Assessment of the behaviour and survival of nematodes under low oxygen concentrations. PLOS ONE, 13(5), e0197122. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0197122

Prati, S., Henriksen E.H., Knudsen R. and Amundsen P.A. (2020). Impacts of ontogenetic dietary shifts on the food-transmitted intestinal parasite communities of two lake salmonids. Int J Parasitol Parasites Wildl, 10;12:155-164. http://dx.doi.org/10.1016/j.ijppaw.2020.06.002.

Ruben, M.O., Akinsanola A.B., Okon M.E., Shitu T. and Jagunna I.I. (2025). Emerging challenges in aquaculture: Current perspectives and human health implications. Vet World. 2025 Jan;18(1):15-28. http://dx.doi.org/10.14202/vetworld.2025.15-28.

Salgado-Moreno, S.M., Gutiérrez-Leyva, R., Carmona-Gasca, C.A., Martínez-González, S., Ramírez-Ramírez, J. C., De La Cruz-Moreno, C.O., & Borrayo-González, J.J.F. (2025). Garlic Powder Evaluation as Feed Additive on Nile Tilapia (Oreochromis niloticus L.) Growth Performance, Feed Utilization, Gill

Parasitic Treatment, and Monogenean Diversity. Fishes, 10(1), 34. https://doi.org/10.3390/fishes10010034

Tanika, C.S., C. Champion, M.A. Coleman and K. Benkendorff (2022). The nutritional and sensory quality of seafood in a changing climate. Marine Environmental Research, Volume 176, 105590, https://doi.org/10.1016/j.marenvres.2022.105590.

Tomamichel, MM, Lowe KI, Arnold KMH, Frischer ME, Irwin BJ, Osenberg CW, Hall RJ, Byers JE. (2025). Warmer Is Deadlier: A Meta-Analysis Reveals Increasing Temperatures Accentuate Disease Effects on Fisheries Hosts. Ecol Lett., 28(7):e70156. https://doi.org/10.1111/ele.70156.

Wu, Z., Xu, Q., Feng, L., Wang, J., Xu, Y., Wu, Y., Zhou, L., & Xu, J. (2026). Effects of Different Stocking Densities on Growth Performance, Stress Resistance, Antioxidant Capacity and Immunity of Grass Carp. Animals, 16(5), 745. https://doi.org/10.3390/ani16050745

Zhou L, Huang J, Jiang Y, Kong J, Xie X, Yin F. (2022). pH Regulates the Formation and Hatching of Cryptocaryon irritans Tomonts, Which Affects Cryptocaryoniasis Occurrence in Larimichthys crocea Aquaculture. Appl Environ Microbiol. 2022 Apr 12;88(7):e0005822. https://doi.org/10.1128/aem.00058-22.