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THE FEEDING HABITS OF GOLDFISH (*CARASSIUS AURATUS*) IN BUND KHUSHDIL KHAN (DAM) AT DISTRICT PISHIN, BALOCHISTAN.

Shehryar Bhatti *[1], Ghulam Dastagir[2], Arshia Sumbal[2], Tahseen Ara[2], Ruqia Abdul wahid[2], Noreen Raza[2], Naveen Jonathan Sampson[3]

[1] Government Boys Degree College Pishin.
[2] Department of Zoology University of Balochistan Quetta.
[3] WTS Tax consultation, Budapest, Hungry.
Corresponding Author, Shehryar Bhatti: shehryarb80@gmail.com
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A B S T R A C T

Carassius auratus fish are classified as bottom feeders, Eury phages, carnivores, and omnivores based on their diet and eating habits. From March 2022 to February 2023, monthly samples of this fish were collected from the Bund Khush Dil Khan Dam in Pishin, Balochistan. 234 fish stomachs were examined during the research period; the categories were empty 41 (18%), quarter 38 (16%), half 67 (29%), three quarters (18.2%), and full 45 (19%). The months of May (13), September, and November (26), January (25), March (25), October (23), February (23), April (23), December (23) August (21), June (81), and July (15) had lower values (16). Debris (22.42), insects (17.95), Plecoptra (10.28), Hemiptera (13.44), Coleoptera (7.44), phytoplankton (6.73), crustaceans (6.18), zooplankton (3.89), send (4.26), higher plants (2.14), algae (2.43), aquatic weeds (1.88), and miscellaneous (2.98) made up the majority of the stomach contents.

KEYWORDS: Carassius auratus, nutrition, Aquatic weeds, Zooplankton, Miscellaneous.

INTRODUCTION.

The Freshwater fish make up the majority of goldfish, which are among the most popular fish kept as pets globally. Goldfish belong to the order Cypriniformes and family Cyprinidae. A typical goldfish's length is 12 inches. Goldfish have bodies that are a mixture of white, yellow, orange, red, brown, and black. The greatest sizes ever measured, according to multiple accounts, were between 19 and 23 inches in length and weighed a maximum of 4.5 kg. It has been reported that in captivity, live spane of goldfish is 05 to 10 years. Due to considerable selective breeding the goldfish can greatly in size, body shape, fin structure, and color (Gurung, et al., 2018). The Goldfish (Carassius auratus) is one of the most well-known and economically significant species. its wide range of morphological adaptation and variety It was spreading around the world from China to Eastern Europe (Ota 2016).

These days, the amount and nutritional value of the food supplied has a significant impact on the fish's growth, the predominant method used to cultivate this species is intense culture (Kaiser et al., 2003). Aquaculture successfully dependent on the quality and availability of food, which affects fish growth throughout their life cycle. The earlier life stage in a production cycle is thought to be the most crucial time for the majority of fish species (Abi-Ayad 1994). The quality and availability of food, which impacts fish growth throughout their whole life cycle, is a major factor in aquaculture success. For most fish species, the earliest life stage in a production cycle is the most critical period for young goldfish to survive and develop, required proper diet (Kestemont 1995).

In research on the impact of neuropeptides on feeding behavior addition, the goldfish (Carassius auratus) is an often-used as a model animal. The protein and lips are rich source of feeds are essential for increasing the survival rate and growth of larvae. Furthermore, due to their swimming movements in the water column and the fact that the medium is clean the live feeds are easily identified and captured (Conceicao et al., 2010). In larval stage live feeds are commonly used such as Artemia sp., Daphnia sp., Tubifex sp., and Moina sp.

RESEARCH AND METHODOLOGY

Study Design

With a population of 12.34 million and a land size of 347,190 sq. km, Balochistan is the largest province in Pakistan in terms of land area (Census, 2017). Pakistan's low population density which makes up more than 44% of the nation's total geographical area is a result of the country's hilly terrain and dearth of water. Geographically, the province is composed of snow-capped mountains, dry deserts, and long lengths of desolate coastline. Most of these lofty peaks are situated at an elevation of 1500 meters above sea level. The province is divided into seven divisions and 37 districts. Even yet, the Pishin district is part of the goldfish study area.

Khush Dil Khan Bund Dam district Pishin

Collection and preservation of Goldfishes fauna

Goldfish and water samples were randomly gathered from each selected site's Khush Dil Khan Bund Dam and kept in specimen vials containing 70–80% ethyl alcohol. Between thirty and fifty samples were taken from each site. The habitat and other biological characteristics were also mentioned. The specimens were brought to the central limnology laboratory of the zoology department either that same day or the next day for additional description. Before testing, the mineral-coated skins, scales, and fins were briefly immersed in a mild oxalic acid solution. Following this, they were rinsed with tap water and kept for the remainder of the study.

Identification of Goldfishes Fauna

The form, size, color, ornamentation, and body coiling of a goldfish, in addition to its many scale characteristics, will be utilized to identify it. Their size and form, whorl count, and aperture size and shape allow them to be identified from one another. The length, shape, and quantity of the scales are extra. The design of the Opercula (trap doors) and whether or not they are present. Dimensions, intersection, and form the apex's depth or narrowness Shape, imperforation, and perforation. The exterior coating's color and pattern (striated, ridged). One more morphometric parameter will be used to calculate the scale position.

The weather has the biggest impact on goldfish migration. The individuals will be swiftly gathered and put in clearly marked plastic containers for further analysis. The examination is done to make sure the identity markings aren't hidden after the body has been cleaned. Following that, the samples will be arranged into groups based on how similar they are morphologically. After determining the scale and fin size, form, color, and decoration, an investigation will be carried out.

Research Analysis Tools Fish Identification;

Identified fish samples by following established protocols and instructions (Imran *et al.*, 2021; Manon & Hossain, 2011).

Gut Content Analysis

Each fish was carefully dissected, its stomach contents removed, and it was then soaked in formalin (5–10%). examined the parts of the intestine using an ocular lens (Nikon Eclipse E200) microscope. All of the species were recognized using the images produced by many

researchers (Hellawell & Abel, 1971; Hyslop, 1980). Additionally, comparable keys are supplied by Edmondson et al. (1959).

Estimation of Gut Contents

Measuring stomach contents using frequency of occurrence (Hynes, 1950) and point volumetric (Pillay, 1952) techniques. A point volumetric technique based on volume Point was used to assign a unique number of points to each dietary component in the gut.

$$Volumetric\ Method = \frac{No.of\ points\ allocated\ to\ component}{Total\ points\ allocated\ to\ subsample} \quad x100$$

After assessing the meal components of each sample, the stomach contents are estimated and recorded. There was a count of the number of intestines where food items were found. After that, each food item was counted and its percentage to the overall number of guts was expressed, indicating how frequently it occurred (Hynes, 1950).

$$P = \frac{b}{a}x100$$

a = Total of the fishes observed with food in their guts,
b = The number of fishes that possess a specific food ingredient,
P = Percentage of each food item's occurrences.

Gastro-Somatic Index

By determining monthly fluctuations in eating intensity and applying the necessary formulas by (Mesoenyama, 2017; Nikiforov- Nikishin et al., 2022), as cited in (Achakzai et al., 2015), the gastro-somatic index was computed.

$$GaSI\ (\%) = \frac{weightofgut(g)}{weight\ of\ fish(g)}x100$$

Gut Fullness and its Category

measured the degree of stomach fullness using the gravimetric method (Hynes 1950).

$$(Gravimetric\ method\ ) = \frac{Total\ gut\ contents\ weight\ (g)}{Total\ Fish\ weight\ \ (g)}x100$$

Each of the five groups representing (25 %), (50 %), and (75 %) of the total stomach content of the Carassius Auratus samples was full (100%), empty (0%), and quarter, half, and third quarter.

Index of Preponderance

The relative importance of gut contents, frequency of occurrence, and volume variation of food components are all researched in relation to the classification of various food components, and the index of predominance offers trustworthy information on these topics employed a formula by Natarajan and Jhingran (1961) to determine the preponderance index

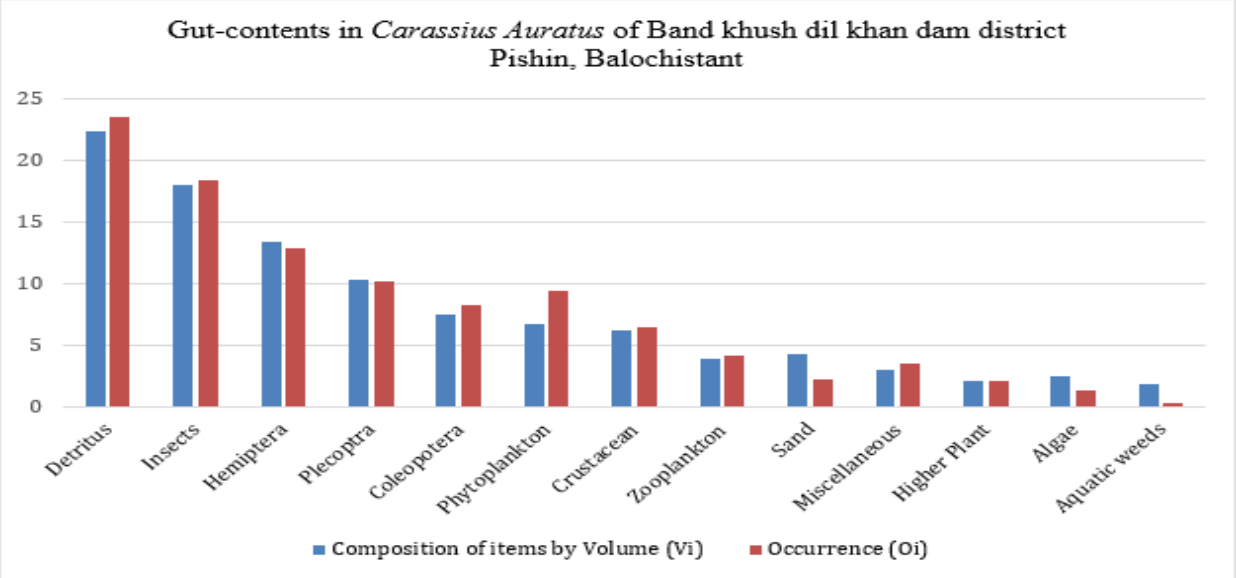
(Mohan & Sankaran,1988).

$$I = \sum \frac{ViOi}{ViOi} x100$$

Where:
I = index of Preponderance
Vi = Volume Percentage
Oi= Occurrence Percentage
∑ = Summation

Table 1. Different gut contents in *Carassius Auratus* of Bund Khush Dil Khan Dam district Pishin, Balochistan

S. No	Food items	%Compositio n of items by Volume (Vi)	Occurrence (Oi)	ViOi	Index of preponderance I=ViOix100/□ ViOi
1	Detritus	22.42	23.53	527.54	41.48
2	Insects	17.95	18.35	329.38	20.71
3	Hemiptera	13.44	12.9	173.37	13.45
4	Plecoptra	10.28	10.23	105.16	8.34
5	Coleopotera	7.44	8.27	61.52	6.05
6	Phytoplankton	6.73	9.38	63.127	3.74
7	Crustacean	6.18	6.45	39.861	2.23
8	Zooplankton	3.89	4.20	16.338	1.5
9	Sand	4.26	2.19	9.329	1.05
10	Miscellaneous	2.98	3.44	10.251	0.67
11	Higher Plant	2.14	2.08	4.451	0.5
12	Algae	2.43	1.35	3.280	0.25
13	Aquatic weeds	1.88	0.28	0.526	0.03

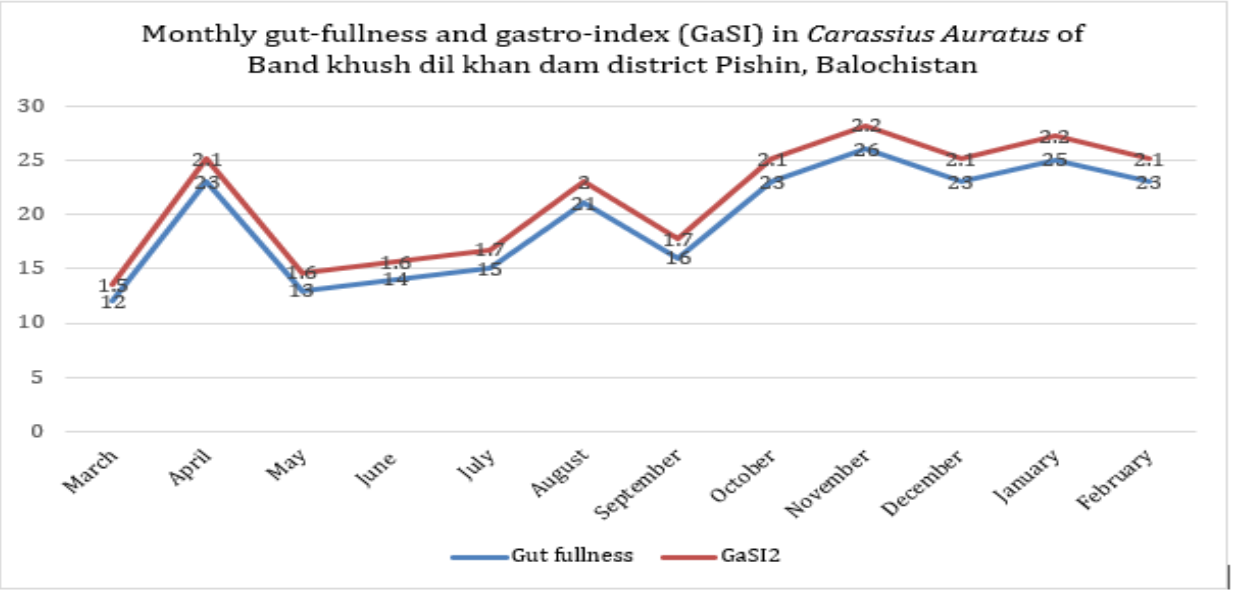


Gut Fullness and Gastro-Somatic Index (GaSI)

In November (26), January (25), March (25), October (23), February (23), April (23), December (23) August (21), June (81) and July (15) months of May (13), September, and October (23), there were disparities in the GaSI and stomach fullness (Table 2).

Table 2: Monthly gut-fullness and gastro-index (GaSI) in *Carassius Auratus* of Bund Khush Dil Khan Dam district Pishin, Balochistan.

Months	**Gut fullness**	**GaSI**
March	12	1.5
April	23	2.1
May	13	1.6
June	14	1.6
July	15	1.7
August	21	2
September	16	1.7
October	23	2.1
November	26	2.2
December	23	2.1
January	25	2.2
February	23	2.1
Average	**19.5**	**1.90**

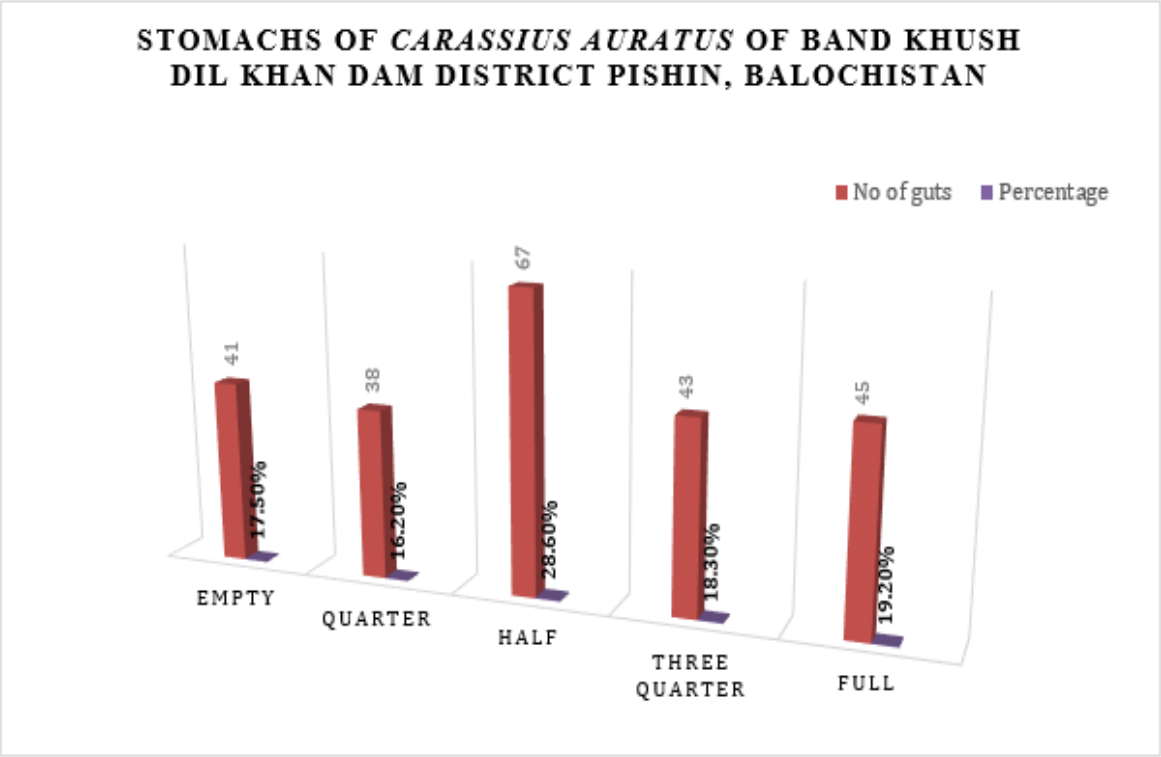


Stomach Categories

234 fish's stomachs were examined over the course of the study, and the classifications were as follows: empty 41 (18%), quarter 38 (16%), half 67 (29%), three quarter 43 (18.2%), and full 45 (19%).

Table 3: Stomachs of *Carassius Auratus* of Bund Khush Dil Khan Dam District Pishin, Balochistan

State	No of guts	Percentage
Empty	41	18%
Quarter	38	16%
Half	67	29%
Three Quarter	43	18%
Full	45	19%
Total	**234**	**100%**



DISCUSSION

Feeding behavior is a complex habit that is closely associated with food intake. Fish exhibit a wide variety of feeding habits and patterns, making them suitable experimental models for studying the regulation of feeding behavior. The aquatic aspect of fish often poses challenges for biologists. But as goldfish larvae require a somewhat constant temperature and a stable food source, rigorous grow-out is best done in controlled environments under close supervision using appropriate feeds. Water salinity affects a number of physiological processes in goldfish, including growth (Boeuf 2001; Engström-st et al., 2005). Thus, larval rearing at low salinities yields higher growth and survival rates than in freshwater conditions for certain freshwater species. Goldfish, koi, and herbivorous fish, including some species of catfish and cichlids, have diets that include fiber and components derived from plant proteins, such alfalfa meals, spirulina, and soy (Chapman 2000). However, due to their high cost and inability to satisfy the dietary requirements of the relevant/target species, many of these feeds seem to be underutilized.

Moreover, it seems that continued use of these meals does not result in continuous growth. Global climate change exposes aquatic species to a growing array of environmental stresses, generating new selective pressures that affect their physiology, behavior, and ultimately fitness (Schinegger *et al.*, 2018). At high temperatures, organic chemicals can become more absorbed and toxic (Nadal *et al.*, 2015). In research, on the Impects of neuropeptides on feeding behavior the goldfish (Carassius auratus) is used as a model animal (Nakamachi *et al.*, 2006). The fish culture effectiveness is depends on the hatchery's capacity to provide seed abundance and their high-quality. A Fish larvae have slow growth and a high mortality rate, making this an important stage. One broodstock is probably capable of producing comet Goldfish larvae, which have a 30% chance of surviving. One of the most important aspects of comet goldfish larvae feeding is the nutritional requirements of the feed (Mellisa, Rahimi & Umiati 2018). Numerous authors examined the relationship between feeding frequency and food intake as well as the development of edible fish (Marian et al., 1982). When feeding frequency was increased, Wang et al. (1998) found that fewer treatments resulted in inter-individual size variance.

While Zhou et al. (2003) conducted some study on the effects of diet on ornamental fish growth and reproduction, the effects of feeding frequency on ornamental fish growth and reproductive performance have received less attention. They found no evidence of any impact of changing the frequency of feeding in young Carassius auratus gibelio gibel carp.

Gupta and Banerjee (2009) state that guppy and mosquito fish have long been successfully employed as mosquito biocontrol agents in India. Aplocheilus sp. has also been employed in this capacity to a lesser degree, and goldfish are thought to be effective mosquito larvae consumers.

CONCLUSION

The study looked into the eating patterns and intestinal chemistry of goldfish from Pishin's Bund Khush Dil Khan Dam. Carassius Auratus is a fish that is classified as an omnivore. Researchers may easily discover and perform studies on Carassius Auratus because it is a fish that is both widely spread and significant to Pakistan's economy. Based on the research conducted on the feeding and dietary habits of the species, the following recommendations are provided to ensure appropriate management.

It has been proven that unauthorized fishermen sometimes catch fish that are undersized. If sufficient safeguards are not reinforced, this will result in a decline in stock. More research is necessary to understand the interactions of Carassius Auratus with other species and its food selectivity on temporal and geographical dimensions, as the existing work may not be sufficient to provide a complete picture of the fish's feeding habits. The current study showed that the ecological balance of the Bund Khush Dil Khan is sufficient for macrophytes, benthic organisms, and detritus—all of which were common food sources for Carassius Auratus. It goes without saying that if there are problems with the ecosystem, the species will have food. Consequently, it's critical to sustain the ecological balance of the dam in an appropriate way.

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