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Dietary Composition and Feeding Habits of the Assuan Labeo, Labeo horei (Heckel, 1847) (Pisces: Cyprinidae) in Lake Chamo, Ethiopia

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Abstract

The Assuan labeo, Labeo horei is an ecologically and economically important fish of Lake Chamo, thus the food and feeding habits of the fish were investigated in order to provide information essential for its sustainable management. Fish specimens were collected monthly from sampling stations at Lake Chamo from July 2022 to January 2023. A total of 462 specimens were collected and 355 non-empty gut samples were analyzed for feeding habits of fish using frequency of occurrence and volumetric methods. Phytoplankton and detritus were the most important food items occurring in 99.4% and 100% of the guts and accounting for 51.9% and 36.4% of the total volume of the food, respectively. The contribution of macrophytes, insects and zooplankton were relatively low. The result revealed that L. horei was omnivores in its feeding habits. There is, however, need for a systematic closed fishing regime to be employed in order to make way for sustainable growth of L. horei fisheries in the lake Chamo as the fish candidate for future aquaculture development.

Keywords: feeding habit, Labeo horei, Lake Chamo, food, omnivores.

Introduction

Background and Justificaton

The Assuan labeo, Labeo horei is found across Northern Kenya and the majority of the Ethiopian drainage basin (Elias et al., 2013). It is extensively dispersed in Ethiopia's Rift Valley basin, Abay basin, and Baro-Akobo basin, (Awoke, 2015). It is one of Ethiopia's economically important fish species (Lakes Fisheries Development Program, 1996). The yearly production of L. horei from Ethiopia's inland water bodies is estimated to be around 365 tons per year. However, L. horei are less available in local markets as a result of the reduction of fish species brought on by overfishing and parasite infection (Elias et al., 2013). The study of diet and feeding patterns of fresh water fish species is a topic of continual research. This is so that an effective management program for fish collection and culture may be developed (Shalloof & Khalifa, 2009). Moreover, research on fish natural feeding allow for the identification of trophic interactions in aquatic ecosystems, as well as the composition, structure, and stability of the ecosystem's food webs (Adeyemi, 2009; Otieno et al., 2014). Also, the knowledge is essential for managing fish in a controlled environment and developing the proper diet for fish in aquaculture (Adeyemi, 2009). The investigation of fish stomach contents gives vital information into the feeding pattern as well as qualitative and quantitative assessment of feeding habits. Diet and dietary habits information is useful in making fisheries resource management. The examination of fish diet and feeding patterns is an essential part of fisheries management. Fish nutrition reflects a combination of several essential ecological components, including behavior, condition, habitat utilization, energy intake, and inter and

intraspecific interactions. Food, feeding patterns, and gut content analyses can be used to assess habitat preferences, prey selection, the consequences of ontogeny, and the development of conservation strategies. Feeding habit research might be carried out to explore the most often ingested prey or to assess the relative relevance of different food kinds to fish nutrition and measure the ingestion rate of particular food categories. For many years, direct investigation of stomach material has been used to understand the dietary patterns of fish (Hyslop, 1980). It is virtually impossible to gather sufficient information of food and feeding habit of fish in their natural habitat without studying its gut contents (Manon & Hossain, 2011). Nevertheless, direct gut content analysis, often performed by dissection or evacuation and evaluation of gut material, is still the most widely used and easiest approach, with enormous potential and adequate for most biological research (Elias et al., 2012). Investigated the diet composition, length-weight relationship, and condition factor of L. horei in Lake Hawassa and discovered that the species' diet consists of phytoplankton, insects, detritus, macrophytes, gastropods, and fish. (Assaminew, 2005; Ermias et al., 2011) investigated the diet of L. horei in Lake Koka and reported the species' omnivorous feeding habits. Numerous aspects of the biology and ecology of economically significant fish species have been studied in Lake Chamo (Elias et al., 2003, 2012; Hailu, 2013; Hailu & Seyoum, 2001). Nevertheless, there is a no data on biometric traits, feed and feeding habits. This necessitates an investigation into feed and feeding habits of L. horei from Lake Chamo, with the goal of providing the scientific knowledge required for appropriate stock exploitation and management in the wild and under culture, given that L. horei is one of the most commercially important fishes in Lake Chamo's catches.

MATERIALS AND METHODS

Description of the Study Site

This study was carried out in Lake Chamo, Arba Minch, Ethiopia (Figure 1). Lake Chamo is located at latitude 5°42′–5°48′ N and longitude 36°30′–38°30′ E. It is situated at an elevation of 1108 m above sea level, approximately 518 km south of Addis Ababa. The lake has a surface area of 551 km^2 and is the second largest among the rift valley lakes and the third largest in the country. Lake Chamo had a maximum depth of 20 meters according to older data (Amha & Wood, 1982). As the lake has retreated by nearly half a kilometer over the past two decades (Beadle, 1981). Which significantly reduces the surface area, the mean depth of the lake may have altered. The Kulfo River, which enters from the north, and two less significant rivers, Sile and Sego, which enter from the west, are the main sources of water for Lake Chamo. In spite of the fact that it now lacks a visible surface outflow. According the study conducted by (Elias et al., 2003), there are more than 20 different fish species in the lake. However, a few species such as O. niloticus (L.), L.horei, Bagrus docmac (Forsskal), C. gariepinus (Burchell) are found to be commercially important.

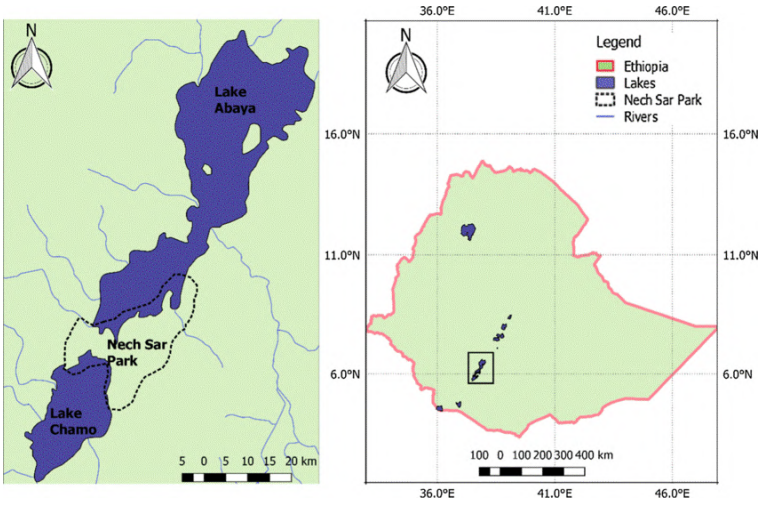


Fig. 1. Map of Lake Chamo

Sampling of fish and measurement

Monthly fish samples were taken from the lake and brought to the Fishery Laboratory of Hawassa University from July 2022 through January 2023. The mesh size used in commercial gill nets ranges from 6 to 8 cm. Gill nets were deployed late in the day and removed the next morning. To the closest centimeter and gram, the TL and TW of each fish were measured immediately following being captured. Each fish was then dissected, and the gut contents were transferred to a labeled plastic bottle containing a 5% formalin solution. Those fish with no gut content were noted as empty gut. The preserved gut contents were delivered to the laboratory. According to a five-point maturity scale (immature, maturing, ripening, ripe, and spent) that was used for this purpose, the gonads of each fish were removed, weighed to the nearest 0.01 gram, and their maturity stages were visually rated and recorded. The ovaries were split longitudinally and turned inside out, to ensure the penetration of the preservative before they were stored in

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labeled jars. At the end the ripe ovaries were preserved in 5% formalin solution for fecundity estimation (Bagenal & Tesch, 1978).

Food and Feeding Habits

Each gut's preserved contents were put onto petri dishes in the lab. Each food item was recognized to the lowest taxon feasible using description, images, and keys from the literature. Larger food items were identified by sight, whereas small food items were identified microscopically (Defaye, 1988). Following identification, food items detected in the stomach content were recorded, numbered, and volumetrically quantified.

Determining dietary composition

The frequency of occurrence approach and volumetric analysis were used to assess the relative relevance and contribution of each food item to the diet of L. horei (Hyslop, 1980). Below is a brief summary of each method:

A. The frequency of occurrence

As a proportion of all the non-empty stomachs analyzed, the number of gut samples containing one or more of a certain type of food item was calculated. According to (Hyslop, 1980), (Allen & Wootton, 1984), this is referred to as the frequency of occurrence and represents the percentage of the population that consumes that specific food item.

B. Volumetric analysis

The food items detected in the intestines were divided into different taxonomic groups, and the water displaced by a collection of items in each category was measured in a partly filled graduated cylinder. The volume of water displaced by each food type was represented as a proportion of the total volume of stomach contents (Bowen, 1983).

Estimation of seasonal diet composition

Seasonal differences in L. horei eating habits were investigated using the frequency of empty gut, as well as data on the relative contribution of important items assessed by frequency of occurrence and volumetric analyses.

Data Analysis

To assess food and feeding habits, data were obtained and entered into SPSS and Microsoft Office Excel 2016 version. Results were finally presented using tables.

TABLE 1
FREQUENCY OF OCCURRENCE AND VOLUMETRIC CONTRIBUTION OF DIFFERENT FOOD ITEMS IN THE DIET OF 355 L. HOREI FROM LAKE CHAMO

Food items	Freq. of Occurrence (%)	Total volume	Volume (%)
Phytoplankton	99.4	926.5	51.9
Blue green algae	20	81.69	4.5
Planktolyngbya	42	580.75	32.6
Botryococcus	12.4	57.3	3.2
Diatoms	25	206.72	11.6
Detritus	100	650.1	36.4
Macrophytes	98.9	58.73	3.3
Zooplanktons	98.9	56.65	3.2
Copepods	98.9	56.65	3.2
Insects	89	93.77	5.3
Diptera	89	93.77	5.3

RESULT AND DISCUSSIONS

Food composition

During the experiment, a total of 462 gut samples were taken, of which 107 (23.2%) were empty. The rest 355 guts (76.8%) contain a diverse array of plant and animal dietary sources. Insects, zooplanktons, and copepods were food items of animal origin, whereas macrophytes, detritus, blue green algae, green algae diatoms were food items of plant origin (Table 1).

A. The frequency of occurrence

According to the frequency of occurrence, detritus were determined to be the most essential dietary items in the stomach (100%) (Table 1). The high frequency of phytoplankton occurrence was mostly owing to planktolygbya, which were 42%.

B. Volumetric analysis

In terms of volume, phytoplankton and detritus was the most significant food items, accounting for 51.9% and 36.4% of total volume the food items. Following phytoplankton and detritus, insects, macrophytes and zooplankton 5.3%, 3.3% and 3.2% of the total volume of food items respectively and had a minor role in the diet of L. horei in Lake Chamo fisheries.

The dietary items discovered in the L. horei stomach contents included phytoplankton, detritus, insects, macrophytes and zooplankton (Table 1). In Lake Chamo, L. horei mostly consumed phytoplankton and detritus insects, macrophytes and zooplankton. In comparison to the current study, the predominant food items of L. horei in Lake Koka were macrophytes, debris, and aquatic insects (Assaminew, 2005). Similarly, in Lake Tana, L. horei' diet was dominated by benthic prey species, particularly insect larvae and debris (De Graaf, 2003). Studies on the diets of L. horei from different inland bodies of water in Africa and Asia have revealed that they are

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omnivorous and that the fish may alter their diet based on prey availability, seasonal variations, and geographic location (Admassu & Elias, 1997; Nagelkerke, 1997). The considerable incidence and volumetric contribution of phytoplankton and detritus in the gut of L. horei demonstrated the importance of this food item in their diet. During the current investigation, no piscivory was found in the diet of L. horei. This is most likely owing to the presence of C. gariepinus, a top predator that feeds on C. carpio, O. niloticus, and Barbus sp. Due to the lack of mouth teeth and a lack of stomach acidity, piscivory is uncommon in Cyprinids (Desta et al., 2006).

Seasonal Variation in L. horei Diet

In Lake Chamo, there was a noticeable difference between the amounts and type of food that L. horei devoured between the dry and wet months. In general, there were substantially more food items consumed during the dry month than there were during the rainy month (Table 2).

TABLE 2
FREQUENCY OF OCCURRENCE AND VOLUMETRIC CONTRIBUTION OF DIFFERENT FOOD ITEMS DURING DRY AND WET SEASONS

Food items	Dry season		Wet season	
	Frequency (%)	Volume	Frequency (%)	Volume
Phytoplankton	92	57.2	89.8	50.4
Detritus	48	33.3	45	34.6
Insects	39.4	5.0	39.7	4.7
Macrophytes	43.6	4.0	49	3.2
Zooplankton	42.8	2.0	49	3.2

During the dry month, the most significant dietary item was phytoplankton and detritus. They were found in 92% and 48% of stomachs respectively and contributed 57.2% and 33.3% of total food content. The most significant food source during the wet month was Phytoplankton and detritus which were found in 89.8% and 45%, of the guts and made up 50.7%, 34.6 of the overall amount of food. Insects, macrophytes and zooplanktons made a comparatively minor impact. The contribution of food items of a plant origin was relatively high during the wet month, whereas the contribution of animal origin was very low. Seasonal fluctuation in food kind and proportion was slightly noted during the dry and wet seasons of the year. Phytoplankton and detritus being the most important food sources during the dry period. Detritus were most likely consumed with insects while the fish was attempting to select insects from the sandy materials using their ventral mouth projection, which is designed for benthic feeding (Adeyemi, 2009). Likewise dry season, during the wet season, phytoplankton, detritus, insects, macrophytes and zooplanktons were the most important food sources. Floods that brought plant material pieces into the lake might be the cause of the detritus, insects, macrophytes and zooplanktons. According to (Balcombe et al., 2004), with high water levels in a Sri Lankan reservoir, Barbus sp. devoured more phytoplankton and detritus and fewer insects. In trophic dynamics in lentic systems, high water levels are characterized as resource rich, whereas low water levels have inadequate resources (Balcombe et al., 2004). Food supply varies throughout the year in the tropical region owing to seasonal variations, and fish feeding habits are affected by seasonal fluctuation (Peder, 2009). The diet of L. horei varied little between dry and wet season. The relevance phytoplankton and detritus was dominating across both dry and wet season of the year, while insects, macrophytes and zooplankton contributed little regardless of season. The minimal difference found was that insects' macrophytes and zooplankton were rather negligible in the diets of L. horei in dry season, but they are prominent food items in the wet season. Furthermore, insects, macrophytes and zooplankton that were prominent in the wet season were very insignificant in dry season. The current study's findings are consistent with those of (Desta et al., 2006). According to (Desta et al., 2006), when L. horei grows in size, it shifts to piscivorous feeding habits. However, no fish prey was found in the current investigation. Spataru and Gophen (1987) observed a lack of ontogenetic diet shift in B. altianalis in Lake Kinneret (Israel). As a result, small and large sized fish consumed similar food items. The fact that L. horei consumes a variety of foods and that its diet varies depending on seasonal availability of feed items and its size in various water bodies throughout Ethiopia indicates that it is a polyphagous animal that eats whatever is in its environment. Cyprinid fish frequently engage in polyphagy. (Sibbing, 1998) and (Cambray, 1983).

Conclusions

This study revealed that Phytoplankton and Detritus were the most important food items for L. horei in Lake Chamo, whereas insects, macrophytes and zooplankton had minor contributions. Phytoplankton and Detritus dominated the food items throughout dry and wet season, while the contributions of the other food items (i.e. insects, macrophytes and zooplankton) were insignificant. celebrated and unique bouquet.

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CONFLICT OF INTEREST

The author(s) declare that they have no known competing financial or non-financial, professional, or personal conflicts that could have appeared to influence the work reported in this paper.

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