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Predator Prey Relationship of *Hydrocynusforskalii* (Cuvier 1819) in White Nile Reservoir around Kosti and Eljabalain Area

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ABSTRACT

The objective of the present study is to determine the food composition, feeding behavior and establish predator prey relationship of Hydrocynus for skalii. The study area is southern part of White Nile reservoir in area around Kosti and Eljabalain. About 200 specimens of fish were collected from landing site. Some morphometric characteristic related to feeding behavior was measured. The stomachs dissected, the contents were analysis and the stomachs and intestine dimension were also measured. The result of morphometric of mouth gape, eye diameter, stomach length and intestine length are important for prey predator interaction. The stomach content analysis showed 61% of content are identifiable out of which 23.4% are Alestes species, 30.9% other species, 20% crustacean's manly shrimp and insect larvae 25.5%. On the other hand H. forskalii in size range (41-60) cm are carnivorous. while in the range of (10-30) are almost crustaceans and insect larvae eaten and in range of (31-40) have a wide range of feeding habits and behavior. Thus it does not have a specific food depend on it and this positively revealed good opportunity to survive.

Keywords: *Predator, Prey, Stomach contents, Hydrocynusforskalii, White Nile.*

INTRODUCTION

The world wide of fishes makes up more than half of 55,000 species of living vertebrates (Gene *etal*, 2009). Along with this remarkable ecological diversity, different feeding habitat, behavioral of feeding and all sort of life in aquatic medium. Fishes have been ecological dominants in aquatic habitats through much of the history of complex life. Between these habitats there are many ecological zonation and diversification on food and feeding behavior which is vary according to species and ecological relationship. Predator and prey are associated with feeding relations were fish depend of fish, insect, invertebrate, crustaceans and others. Predator has many biological and morphological characteristic for adaption to this behavior, such characters, large and non-protractile mouth, strong teeth, large eye, reduced or vestigial gill rakers, short intestine and elongated rather simple stomach (Bailey, 1994).This study is being set out to examine some morphological characters, food composition and predation interaction of *H. forskalii*. The family Characidae is one of the largest families of the teleosti and represented by many species in African fresh-water (Boulenger, 1907), this family in the Sudan is represented by three species distributed in almost all natural water, they are *H. brevis* (Cunther 1864), *H. vittatus* (Castelanu, 1861) and *H. forskalii* (Cuvier 1819) (Bailey, 1994).Many investigators studied food and feeding habitats of different fish, Elias (2005)and Olojo, *et al*. (2003) determined feeding habitat of freshwater carnivore's fish and compared feeding behavior of *H*. species with *Lates niloticus* in Osun River. Cesar, *et al*. (2004) and Sarah, *et al*. (2011) described that the food quality determined the species composition of fish and established the fact that food is a basic determine factor in matters such as distribution, rate of growth and other life aspect. The food and feeding habits of many predatory species have also been reported. The species *H. forskalii*, *Hepsetusodoe*, *Channaobscura* and *Lates niloticus* were found to be principally piscivorous in all studied habitats (Sarah, *et al*., 2011). Closeinvestigation of feeding behavior of *H. forskalii* have drawn the attention of researchers as to various behavioral activities adaption to the ecological

habitat. In this respect the activity of workers like Tatenda, *etal*. (2012) and Francois and Clinton. (2018) are good examples, the first work reported on food and feeding habitat and behavior in Sudanese fresh-water fish is Pekkola (1919). Predator-prey interaction of fish species in Jabel Aulia reservoir are poorly documented and a Little is known about the feeding ecology of indigenous species in this large reservoirs with most studies having been done in Nile tilapia manly *Oreochromisniloticus* and *Clariasgariepinus* (Hagar, 2017). Other description of relationship between various fish species and their prey has been made by Baras, and Lucas. (2002) and Darwall, *etal*. (2009) when correlate between *H. forskalii* and its prey species in South African fresh water has been described by the relationship between *H. vittatus* and its prey in other fresh water Lake. Technical report reported by (FAO, 2016) mentioned that swallowing the prey whole appears to be a common habit for most freshwater predatory fishes in the Nile system. Same report added that Stomach content studies on freshwater fishes had been conducted to provide wealthy of information on their dietary requirements in their natural habitats (FAO, 2017). The present study aims to determine the food composition, feeding behavior and establish predator prey relationship of *H. forskalii*.

MATERIALS AND METHODS

Study Area

The study was carried out in the Southern part of Jabel Aulia reservoir295 Km South of Khartoum in area around Kosti and Eljabalain 23-3 N and 39-22 Eat five landing site and three fish market. This study is an important area for fish's diversity and fish production. *H. forskalii* is commonly available in this area between Kosti and Eljabalain were this study is being carried out. *H. forskalii* is commercially considered as a fish of high grate (first class) in wet salted processing fish.

Field Study

During the study period, 200 specimens of *H. forskalii* ranging from 10.2 to 60.8 cm total length and 9 to 1,700 gram weight are collected and examined. Fish are usually brought and identified according to the key of Bailey (1994), and examined as soon as they are brought in fresh condition and they never kept in formalin and refrigerator to avoid any possible damage in fish parts. The following morphological characteristic of fish are measured to nearest centimeters, the total length (TL), the standard length (SL), the head length (HL), the eye diameter (ED), the mouth gape (MG) of each specimens are measured by using scale micrometer and venire caliper. After recording the weight of each specimens the fish are dissected and the stomachs are opened, the stomach length and intestine length are measured, the stomach with food are removed and preserved in 5% formalin solution to be examined later, but these which contained large prey are examined on the spot.

Stomach Content Analysis

For each stomach the prey and food items identified as far as possible to various classified groups. The relative importance of food items was determined using frequency of occurrence, percent composition by number and volumetric analysis. The number of each type that are found whole in the stomach are also measured to estimate the size of prey ingested.

Data Analysis

The present parameters are compared with standard length to find morphological relationship and predator prey relationship. Statistical analysis is done by applying the regression analysis and correlation coefficient for morphometric studies.

RESULTS

Morphometric Study

The result of morphometric characteristic of *H. forskalii* shows that nearly perfected isometric growth in all body dimension table (1). The regression of total length and head length of fish against standard length gave high correlations coefficient which are high significant resulted of that each parameter from those could be used for length determination. The study of morphometric such as mouth gape, eye diameter, stomach length and intestine length are important for prey predator interaction, these morphometric against standard length resulted high correlation and significant. However *H. forskalii* can easily detected its prey location, and stomach length is gradually increased with increasing length of fish.

Table1. *Regression analysis for different body measured of H. forskalii (Y) against standard length (X) (No= 200 specimen).*

Parameter	Regression coefficient (b)	Intercept (a)	Regression equation "Y=a+bx"	Correlation coefficient (r)
Total length	1.202	0.484	Y=0.484+1.202X	0.99
Head length	0.192	0.881	Y=0.881+0.192X	0.96
Mouth gap	0.115	0.121	Y=0.121+0.115X	0.89
Eye diameter	0.029	0.355	Y=0.355+0.029X	0.88
Stomach length	0.412	0.934	Y=0.934+0.412X	0.85
Intestine length	0.891	1.520	Y=1.520+0.891X	0.82

Stomach Composition

The determination of food and diet of *H. forskalii* are basic entirely upon the examination of the contents of stomach. 154 stomach (77%) of the total number of stomach are contents and 94 stomach (61%) of which are identifiable and 60 stomach (39%) of which are unidentifiable contents table (2). The analysis of the stomach contents of identifiable contents (94 specimen) contend various species of Alestes fish (22) 23.4%; other species are about (29) 30.9%; crustaceans which is manly small freshwater shrimp (19) 20% and the rest are insect larvae manly dragon fly larvae (24) 25.5%.

Table2. *Contents analysis of 200 stomach examined of H. forskalii (C)*

No	Items	Number	Percentage
1	Number of stomachs with contents	154	77
2	Number of empty stomachs	46	23
3	Number of stomachs with identifiable contents	94	61.04
4	Number of stomachs with unidentifiable contents	60	38.96
5	Stomachs contents analysis of identifiable as:		
	Alestes species	22	23.40
	Other species	29	30.85
	Crustaceans (fresh water shrimp)	19	20.21
	Insect larvae	24	25.53

Table (3) show clearly that *H. forskalii* with in size range examined from (41-60) cm are almost entirely carnivorous which mainly piscivorous and they are mainly depend on fish in their feeding and those of (10-30) are almost changing their feeding behavior from crustaceans to insect larvae, while the size range (31-40) have a wide range of feeding habits and behavior where they tend to feed on small fish and macro-invertebrate.Alestes may play an even more important role in the diet of *H. forskalii* and constitute the most important dietary component of the adult population. The degree of predation upon them is related to the size of predator where as 54.2% of stomachs with identifiable contents are of the fish size are containing Alestes and other species of fish.On the other hand fresh water shrimp considered major diets of small age and size of fish, where 20.2% of identifiable stomach content are containing shrimp while large fish are never feed on shrimp or other crustacean.

Table3. *Stomach identifiable contents analysis of 200 specimen of H. forskalii (C).*

Range of fish length (cm)	No of stomach with prey	Number of stomach content			
		Alestes fish	Other fish	Crustaceans	Insect larvae
10 - 20	13	-	-	4	9
21 - 30	8	-	-	6	2
31 - 40	22	9	1	7	5
41 - 50	17	11	6	-	-
51 – 60	34	19	15	-	-

The relationship between predator size and prey size is presented in table (4), the regression analysis of the size of three prey types, crustacean, insect and fish, presented in *H.forskalii* stomach resulted that the crustacean size and insect against total length of predator gives low correlation where r=0.003 and -0.246 respectively, which are highly significant deference ($p<0.05$). While the regression of fish prey against predator resulted positive correlation which is not significantly deference ($p<0.05$), however the prey size increase with the increasing size of predator.

Table4. *Regression analysis of prey length (cm) against predator length (cm), No of (200) specimen of H. forskalii. (C).*

Parameter (Prey)	Regression coefficient (b)	Intercept (a)	Regression equation "Y=a+bx"	Correlation coefficient (r)
Fish	0.173	3.828	Y=3.828+0.173X	0.18
Insects	-0.013	3.814	Y=3.814-0.013X	-0.26
Crustacean	0.038	-0.135	Y=-0.135+0.038X	0.00

DISCUSSION

Morphometric and Anatomical Characteristics

In this study, some morphometric characteristic are investigated to find out the relation-ship between those parameters during growth of fish. The strong correlation of mouth gape against standard length is confirmed the importance of the relation-ship between prey size and predator mouth size evaluating the feeding behavior of the fish. Study done by Sarah, *et al.* (2011) revealed that *H. forskalii* would not be able to ingest a prey of more than its mouth size, compared with *L.niloticus* which is can ingest a prey larger than its mouth size. Based on anatomical gape, the rate of absolute functional gape increase in *H. forskalii* its similar to that in *L. niloticus* while the strong teeth of *H. forskalii* are more active and functionally stronger than *L. niloticus* teeth.

Food and Feeding Habit

Regarding with feeding habit, the present observation suggest that H. forskalii occurs in virtually all habitats of the area of the study. Other authors argued that Hydrocynus species are mainly restricted to shallow water over sandy bottom an clean open water Sarah, et al. (2011) and Elias, et al. (2005) discussed in some details, the method of feeding and effects of predation by many fish species in Chamo Lake, interesting comparisons can be made with Cesar, et al. (2004) observation with the present information on the feeding of H. forskalii in study area. Francois and Clinton (2018) observed that H. vittatus almost invariable swallows its prey and because of this habit, it preys upon fish much smaller than itself. The study suggested that Alestes spp constitute an important item of food for H. forskalii in area around Kosti and Eljabalaen, similar results were founded by Darwall ,et al (2009) and Baras,et al. (2002) they found that the decline in tilapia stocks and Alestes species in lake Kariba was attributed to predation by H. vittatus and about 50% occurrence of tilapia and Alestes formed 54% of the tiger fish diet. In the present study it's resulted that with increasing numbers oh H. forskalii in study area that resulted in a decrease in stock of prey species, however Alestes species characterized by soft fins and bones relative to Cichlids and many other prey species for their rate of digestion, which is may more rapid than other preys. The study revealed that the H. forskalii changes in to piscivorous in length of (31cm), with reference to Roux (2013) recorded the invertebrates decline in important until they were completely dropped by L. niloticus of more than (50cm TL), beyond which size the predator turned exclusively into piscivorous. The changes in H. forskalii diet may related to the availability, relative abundance and convenient size of prey species into study area. The previous investigation done by Roux (2013) confirmed that the behavior of carnivorous habits of H. forskalii did not mention any kind of food others than fish, yet crustacean and insect remains were also found, while plant material such as diatom, root hairs of water hyacinth and filamentous algae occasionally recorded by Skelton (2001). But due to the fact mentioned by Peel (2012) according to the low of nature, in case of acute hunger animal can eaten materials out of the desired, carnivorous can eat plant materials and herbivorous can shift to carnivorous which is better than death.

Predator and Prey Relation-Ship

Predator-prey clearly investigated in the present study, H. forskalii takes large prey as its time increases, the average size of prey may various, probably depending on the size of prey available, this agree with Creel, and Creel (2002) and Zengeya, and Marshall (2007) were L. niloticus in lake Victoria , sometime adult and large Hydrocynus consumed small size of prey such as shrimp, that suggested preferable prey for predation were not available, but its small size is not available, predator can bit their prey into small parts. *H. forskalii* likewise swallow it prey whole thus imposing a maximum limit upon the size of its prey and sometime swallows prey longer than its stomach (10.4cm prey length and 7.9cm stomach length) and about 24% of prey length is out of predator

mouth, the concept of maximum prey size is the main basis of study done by Winemiller and Winemiller (1994) investigations of predator by *H. vittatus*. Thorstad*et al* (2002) prove that in rare cases *H. vittatus* can attaching fish longer than its length. Other study done by which is revealed that in predator prey length relationship the small *H. vittatus* ingested prey (fish) from small size classes, whereas large *H. vittatus* ingested a wide range of prey sizes ranging from 50-170 mm and showed a positive predator prey relationship. On average, *H. vittatus* consumed prey with a mean of 27.3% of its body length.

Impact of H. Forskalii on other Fish Species

The impact of *H. forskalii* on all other fish species with in its area of distribution is dramatic. It is noticed that the population of Alestes is declined or virtually dis appeared (Personal contact).The present study concerned with the possible effects of predation by *H. forskalii*and the direct impact of predation by this species upon the fish stock, however when assessing the impact of predation in term of biomass of prey fish removed from the population. Although for the time being the strong increase of *H. forskalii*seems to be unfavorable development, the final consequence may be very serious for fish population in the study area. The large number of prey of Alestes are primarily consumers when these are depleted a major part of energy input which may cutoff for fish production. The previous mentioned effects result in strong decrease of total fish yield of the White Nile area. Never the less in terms of overall productivity the method of predation upon large fish by *H. forskalii* is extremely wasteful and the result of loss of biomass is likely to be appreciable.

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