European Journal of Biological Sciences 5 (3): 90-98, 2013
ISSN 2079-2085

DOI: 10.5829/idosi.ejbs.2013.5.3.74156

Some Biological Aspects of Crevalle Jack, *Caranx hippos* (Linnaeus, 1766) from Majidun Creek, Lagos, Nigeria

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Abstract: The present study investigates biological aspects of a small population of Crevalle jack, *Caranx hippos* from Majidun Creek, Lagos, Nigeria between January and December 2010. Nocturnal and diurnal collections of fish were carried out using non return valve basket traps, gill and cast nets. Morphometric data were obtained from the specimens using digital vernier caliper, while total lengths and body weights from measuring board and Sartorious weighing balance respectively. Sexes were differentiated both macro and microscopically. Relatively small quantity of specimens (n=59) was caught, with 54.22 and 45.78% of the population caught in wet and dry seasons respectively. Morphometric data included eye diameter: 0.9-1.41(1.18±0.154), head length: 3.8-5.6 (4.53±0.523) and body depth: 2.6-4.1 (3.31±0.401) cm. The fish measured between 7.5 and 17.3 cm long and weighed 2.91-72.34 g body weight. The length-weight relationship (LWR) equation was LogW=-2.345+3.35LogL (r=0.97). Growth parameter was a positive allometry (b =3.35), the value was within the expected range of 2-4 recommended for normal growth of tropical fish. The condition factor (K) varied from 0.66-1.40 (1.07±0.15). Sex ratio was 1 male:0.72 female and was insignificantly different ($P>0.05$) from the expected ratio of 1male:1female ($X^2_{cal}=1.28<X^2_{tab(n=1,\alpha=0.05)}=3.84$). Temperature, salinity and rainfall played important ecological role in seasonal abundance of *C. hippos*. The biological study of this relatively small population of *C. hippos* is important; therefore, the present study has provided first documented information on its abundance, growth patterns, morphometry, condition factor and sex ratio in Majidun Creek.

Key words: Length-weight relationship · Growth coefficient · Condition factor · Gear · Taxonomy

INTRODUCTION

Crevalle jack (*Caranx hippos*) is a member of the family Carangidae. The family consists of 30 genera and approximately 140 species. Members are well represented in all tropical and subtropical seas. Carangids are pelagic spawners that release large numbers of tiny, buoyant eggs. The larvae may lead a pelagic existence for extended periods while the juveniles of several species are sometimes encountered in brackish estuaries and freshwater. *C. hippos* is one of most abundant carangids in the Atlantic Ocean, with at least two systematic studies placing it within the top five most abundant species, namely lagoons in Nigeria [1] and Chiapas, Mexico [2]. Smith–Vaniz and Carpenter [3] reviewed *C. hippos* complex (Teleostei: Carangidae), with a description of a new species from West Africa. The *C. hippos* species complex comprises three extant species: Crevalle jack, *C. hippos* from both the western and eastern Atlantic Oceans; Pacific Crevalle jack, *C. caninus* from the eastern Pacific Ocean; and longfin crevalle jack (*C. fischeri*) new species, from the eastern Atlantic, including the Mediterranean Sea and Ascension Island. *C. hippos*, growing to a known maximum length of 124 cm and a weight of 32 kg [4], although are generally rare at lengths greater than 60 cm [5].

There are several reviews on aspects of biology of some tropical fishes [6-9]. While there are many studies on Nigerian waters, information is still lacking on fishes of Majidun Creek. Therefore, the present study provides first documented research work on seasonal abundance, growth patterns, morphometry, condition factors and sex ratio of *Caranx hippos* which appeared as a small number in Majidun Creek.

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MATERIALS AND METHODS

Study Site: Majidun Creek is a narrow and shallow water body with an average depth of 3 meters. It lies within latitudes 3°48`E and 4°48`E and stretches between longitudes 6°61`N and 7°12`N. It remains one of the numerous aquatic habitats in Lagos, Nigeria. Ologe, Lagos, Lekki and Epe Lagoons; Yewa and Ogun Rivers; Badagry, Ogudu and Ogbe Creeks are some of the adjourning water bodies. Majidun Creek drains directly into Lagos Lagoon and empties into the Atlantic Ocean via Lagos Harbour. The shore of the creek is denticulate and surrounded with forest, typical of those found in the mangrove swamps and brackish water system.

The present study was conducted on the creek between January and December 2010.

Field Procedures: Water temperature and salinity were determined fortnightly on the field with mercury-in-glass thermometer and salinometer respectively. Annual data on rainfall was collected from Nigeria Meteorological (NIMET) Centre, Oshodi, Lagos, Nigeria.

Diurnal and nocturnal collections of fish specimens were carried out in Majidun Creek. Gears used for fish collection included baited non return valve traps, cast (of 12-22 mm mesh sizes) and gill nets (18-45 mm mesh sizes); two canoes with outboard engines were implored as crafts. Specimens were fixed in 10% formaldehyde buffer solution.

Laboratory Procedures: Specimens were sorted to lowest taxonomy level and identified following [10-13]. The fishing gears were identified with reference to Catalogue of Small Scale Fishing Gears in Nigeria [14].

Data on the total length (TL) and body weight (BW) measurements were obtained for individual fish, standard measuring board was used to determine TL and Sartorious balance (model: 1106) for BW. TL was measured to the nearest 0.1 cm and BW to the nearest 0.01g.

Seasonal Abundance: Sample size from daily collections was taken into cognizance; the seasonal abundance of *C. hippos* was obtained from monthly occurrence data. The percentage abundance was also determined from the data.

Morphometric Characteristics: The morphometric measurements were implored to determine whether there are taxonomic variations among the populations of this fish in the Creek. The morphometric data such as eye diameter (ED), head length (HL) and body depth (BD) measurements were carried out on the individual specimen using digital vernier caliper with fish's head turning left. ED was taken as the diameter of the eye orbit; HL as a distance between the snout and a point directly behind the operculum; BD represented the deepest part of the body (a vertical distance between a dorsal fin base and the ventral fin base). ED, HL and BD measurements were in nearest 0.1 cm.

Length Frequency Distribution: The length frequency distribution of the species was represented by percentage length frequency histograms at intervals of 1 cm. Thus: 7, 8, 9… 17 cm total lengths.

Length Weight Relationship (LWR): Data from the total length and body weight measurements was used to calculate relationships between these two variables. LWR was derived from equation:

$W=aL^b$ [15, 16].

The logarithm transformation of the equation was expressed as:

Log W= Loga+bLogL *L* [15].

This equation is sometimes known as the length-weight key [17]. Where W=fish body weight in grams, L=fish total length in centimeters, a=intercept or constant and b=slope or length exponent and r=correlation coefficient. The "a" and "b" and "r" values were calculated from linear regression of the fish length and weight measurements. The determination of coefficient r^2 was used as indicator of the quality of the linear regressions.

Growth was regarded as isometry when the value of b=3 and allometry when less or greater than 3. The student's t-test was used to verify whether the parameter b was significantly different from the expected 3 (i.e b=3, $p<0.05$). The equation was expressed as:

$t_s=(b-3)/S_b$ [18].

where t_s =student's t test, b=slope, S_b=standard error of the slope (b).

$$S_b = \sqrt{\frac{[(sW/sL)-b^2]}{(n-2)}}$$

where sW=variance of body weight, sL= variance of total length, n=sample size. All the statistical analyses were considered at significance level of 5%.

The 95% confidential interval (CI) for b was determined from equation:

$CI=b\pm(1.96xS_b)$.

Condition Factor (K): The Fulton condition factor (K) was estimated to determine the state of well being of the fish from equation:

$K=W/L^3$ [21].

where W=fish body weight in grams (g), L=fish total length in centimeters (cm) and K= Condition factor.

Sex Ratio: The sex was determined by making incisions from the vent through the throat of the fish to reveal gonads. The gonads were examined both microscopically and by naked eye for sex differentiation. All the discernable gonads were differentiated as males or females. The ratios of the numbers of males to females were subjected to Chi-squared analyses (X^2) (a test of goodness of fit) to compare male:female ratio with hypothetical or expected or theoretical sex ratio of 1:1.

$X^2 = \Sigma(O - E)^2/E$

where, O = number observed and E = number expected.

Statistical analysis: Data processing was carried out using the Statistical Package for Social Sciences (SPSS, version 16) and Microsoft Office Excel soft wares.

RESULTS

Environmental Profiles: The environmental profiles of Majidun Creek, Lagos, Nigeria are presented in Table 1.

Water temperature varied from 25.1 in August to 28.6 °C in February 2010 (27.5±0.27°C). The monthly variations in water temperature were not significantly different ($P>0.05$).

Salinity was as low as 0.20 in July and August and as high as 16.80 ‰ in May 2010. The mean was 6.92 ± 1.93 ‰. The freshwater condition was observed in the creek in June, July and August 2010 (0.20-0.80 ‰) while other months experienced low brackish water condition (1.25-16.80 ‰).

Table 1: Environmental profiles of Majidun Creek, Lagos, Nigeria

Month/year	Water temperature (oC)	Salinity (%0)	Rainfall (mm)
January 2010	27.0	11.30	40**
February 2010	28.6	12.50	41**
March 2010	28.1	14.60	57**
April 2010	28.3	15.50	69**
May 2010	28.2	16.80	100*
June 2010	27.2	0.80	215*
July 2010	27.3	0.20	336*
August 2010	25.1	0.20	214*
September 2010	27.3	1.25	150*
October 2010	27.4	1.30	222*
November 2010	27.9	2.25	77**
December 2010	28.0	6.30	42**
Mean ± S.D	27.5 ± 0.27	6.92 ± 1.93	130.25±27.82

** =dry month, *=wet month

Table 2: The seasonal abundance in *C. hippos* from Majidun Creek, Lagos, Nigeria

Month/year	Abundance	% abundance
January 2010	3	5.09**
February 2010	3	5.09**
March 2010	0	0**
April 2010	5	8.48**
May 2010	6	10.17*
June 2010	7	11.86*
July 2010	2	3.39*
August 2010	10	16.95*
September 2010	0	0*
October 2010	7	11.86*
November 2010	2	3.39**
December 2010	14	23.73**
	59	100%

**=dry month, *=wet month.

Rainfall in Majidun area of Lagos ranged between 40 and 336 (130.25±27.82) mm. Low rains were recorded from January (40 mm) to April (57 mm), November (77 mm) and December (42 mm) 2010. However, heavy rains were witnessed between May and October 2010. The peak of rainfall was July 2010 when rainfall was 336 mm.

The Creek experienced two distinct seasons, dry season was characterized by six (6) months of very low rains; this period included months of January-April, November and December 2010. This period experienced rainfall between 40-77(54.33±15.95) mm. Wet season was characterized by six (6) months of heavy rains between 100 and 336 (206.17±79.59) mm from May-October 2010.

Seasonal Abundance: Table 2 presents summary of the seasonal abundance in *C. hippos* from Majidun Creek. The abundance varied between 0% (in March and September 2010) and 23.73% (in December 2010). The percentage abundance in wet and dry seasons were 54.22 and 45.78% respectively, the environmental profile for wet season was water temperature,

Table 3: Summary of the morphometric measurements in *C. hippos* from Majidun Creek, Lagos, Nigeria

Morphometric measurement (cm)	Range (cm) minimum	maximum	Mean±SE
Eye diameter (ED)	0.9	1.4	1.18±0.15
Head length (HL)	3.8	5.6	4.53±0.52
Body depth (BD)	2.6	4.1	3.31±0.40
Total length (TL)	7.5	17.3	11.46±1.95
ED:HL ratio	3.42	4.33	3.87±0.24
HL:BD ratio	0.68	0.77	0.73±0.03
BD:HL ratio	1.30	1.47	1.37±0.05
HL:TL ratio	1.97	3.09	2.52±0.20

ED= Eye diameter, HL=Head length, BD=Body depth, TL=Total length.

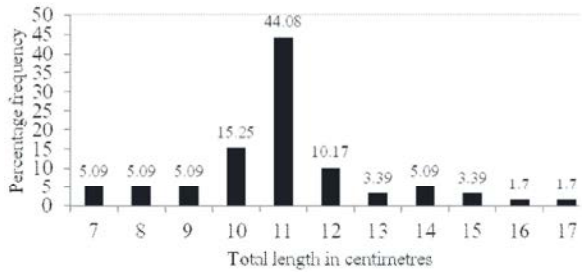

Fig. 1: Length frequency distribution of *Caranx hippos* from Majidun creek.

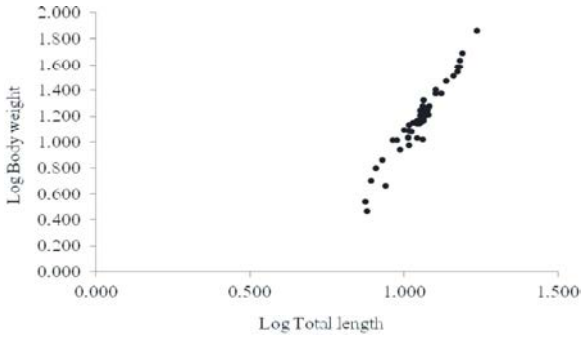

Fig. 2: Log Total length-Log Body weight relationship of *Caranx hippos* from Majidun creek, Logos

25.1-28.2(27.08±1.04) °C; salinity, 0.2-16.8(3.43±6.57) ‰ and rainfall, 100-336(206.17±79.59) mm. In dry season, water temperature=27-28.6(27.98±0.54) °C; salinity=2.25-15.5(10.41±5.14)‰ and rainfall= 40-77(54.33±15.95) mm.

Morhometric Characteristics: Summary of the morphometric measurements in *C. hippos* from Majidun Creek is given in Table 3. The eye orbit (ED) varied between 0.9 and 1.4 (1.18±0.15) cm, the HL was 3.42-4.33(3.87±0.24) times the ED; HL ranged from 3.8-5.6 (4.53±0.52) cm and 0.68-0.77 times shorter than the BD. However, the BD measured between 2.6 and 4.1 (3.31±0.40) cm, its ratio on HL was 1.30-1.47 (1.37±0.05). The TL measurements were within 7.5-17.3 (11.46±1.95) cm and 1.97-3.09 (2.52±0.20) times the HL.

Length frequency distribution: Length frequency distribution of *C. hippos* from Majidun is presented in Figure 1. The distribution patterns showed total length variations between 7 and 17 cm, 1.7% of the fish population measured 16 to 17 cm long and 44.08% were 11 cm total length. Three (3) size groups were clearly defined in the Creek, viz: the small group was represented by specimens measuring 7 to 9 cm total length, medium included specimens that measured 10-12 cm long and large, included specimens that were within 13-17 cm total lengths. The length frequency histograms showed bimodal and a bell shaped distribution.

Length Weight Relationship: The length weight relationship of *C. hippos* from Majidun creek is represented by equation: $W=-46.09L^{3.35}$. The logarithms transformation of this equation in Figure 2 is presented as : $LogW=-2.345+3.35LogL$ ($r^2=0.97$).

Table 4 presents the growth profiles of *C. hippos* from Majidun Creek. The growth coefficient, b of LWR indicated a positive allometric growth pattern (b=3.35) and was significantly higher than the expected and theoretically value of b=3.0 as indicated in student's t-test: t_s =3.282 @ 95% confidential interval (CI) of S_b=3.14<b<3.56 (Table 4). The correlation coefficient value, r^2=0.97 was highly significant (*P<0.05*) between total length and body weight measurements.

Condition Factor: Summary of the Condition factor in *C. hippos* from Majidun Creek is presented in Table 5. The K values ranged between 0.663 and 0.984 (0.753±0.23) in males and from 0.765-1.397 (0.985±0.541) in females. The overall value was 0.663±1.397 (1.070±0.151).

Table 4: Growth profiles of C. hippos from Majidun Creek.

Total length (cm)		Body weight (g)		Growth coefficient						CI of s_b @ 95%	
Min	Max	Min	Max	a	b	r^2	n	s_b	t_s	Lower limit	Upper limit
7.5	17.3	2.91	72.34	-2.345	3.35	0.97	59	0.109	3.282	3.14	3.56

a=intercept, b=slope, r2 =correlation coefficient, n=sample size, sb = standard error of b, ts=student's t-test, CI=confidential interval.

Table 5: Summary of the Condition factor (K) in C. hippos from Majidun Creek, Lagos, Nigeria

	Range		
Sex	Minimum	Maximum	Mean±SE
Males	0.663	0.984	0.753±0.23
Female	0.765	1.397	0.985±0.541
Sex combined	0.663	1.397	1.070±0.151

Sex Ratio: A total of 50 specimens of *C. hippos* showed discernable gonads in Majidun Creek. Of these, were 29 males and 21 females, these numbers presented a sex ratio of 1 male: 0.72 female. The ratio was a departure from the theoretical sex ratio of 1male to 1 female. From the Chi squared analysis (X^2), this departure was not significantly different from the expected ratio of 1male:1female ($X^2_{cal}=1.28<X^2_{tab\ (n=1,\alpha=0.95)}=3.84$).

DISCUSSION

The profile of water temperature, salinity and rainfall of Majidun as presented in Table 1 were typical of what obtainable from tropical and subtropical waters [19]. These parameters are regarded as limiting factors in aquatic environment [20, 21]. Their importance in the aquatic environment can not be overemphasized and they remain most widely studied limnological factors. Temperature affects fish metabolic activity, growth, feeding, reproduction and migratory behaviours of aquatic organisms [22].

Salinities 0.2-16.8 (6.92 ± 1.93) ‰ that were observed in this study are indications that the creek was a low brackish water environment. These values fell within the range of 0.2-16.75 ‰ what were reported in the adjourning Lagos lagoon [19], Ogbe creek [23], Ologe lagoon [24] and Badagry creek [25]. The salinity of water within this creek probably tells us how much fresh water has mixed with sea.

The rainfall patterns in clearly distinguished between wet and dry seasons. These were characterized by periods of heavy (wet) in the months of May-October 2010 and low rains (dry) from January-April and in November and December 2010. Data was in support of Lawson [19] report from the neighbouring mangrove swamps of Lagos lagoon.

Relatively small number (sample size of 59 specimens) of *C. hippos* caught from the creek may be attributed to:

- Activities of sand miners which may adversely affect the spawning ground, increase the siltation level and reduce dissolved oxygen. These may directly cause alterations in the composition of fish assemblages [26].
- High rate of pollution resulting from the domestic sewage, agricultural and industrial wastes.
- Overfishing due to operation of a large number of artisanal fishermen their without proper monitoring from the relevant agencies.

The adults are relatively common especially during October to February [3]. *C. hippos* are reportedly living in both inshore and offshore habitats, with larger adults preferring deeper waters than juveniles. In the inshore environment, it inhabits the shallow flats and sandy bays [27], beaches, sea grass beds, shallow reef complexes [4] and lagoons, which may be open or landlocked. The species is also known to enter brackish waters with some individuals known to penetrate far upstream, however like most euryhaline species they generally do not penetrate very far inland [28], this might suggest its small population in Majidun Creek which is of distance of 30 km away from Lagos coast. Juveniles use estuaries and sea grass beds as their main nursery habitats [29]. The species has been reportedly found in waters with 0-49 ‰ salinities, indicating the species can adapt to a wide range of waters [1] and [30]. Research in the coastal waters of Ghana suggests that the availability of food is the primary control of the species distribution in inshore waters [31].

Morphometric measurements showed some variations in *C. hippos*, however, the variations were not significantly different ($P>0.05$) enough to make a submission that the species was genetically or morphologically different. Their data though may not be fully relied on as determinants for genetic diversity, but their importance in taxonomic characterization of this species can not be overemphasized. These insignificant variations may be due to the geography, ecology and human activities in the creek. Data obtained from this study may serve as template in carrying out systematic and taxonomy study of fish [37, 38].

Three (3) different categories of length were exhibited by *C. hippos* in Majidun creek (Figure 1). Presence of few adults (15.27%) and large number of juveniles (69.50%) in the population may be related to its migratory nature and indication that the creek served as a veritable spawning, breeding or feeding ground for some marine species. Leveque [7] reported some marine fish species (including *C. hippos*) in western African lagoons and lower rivers of coastal basins.

The length weight distributions of *C. hippos* in Majidun creek showed considerable variations in size. The captured fish ranged from smallest size of 7.5 cm (2.91 g) to biggest size of 17.3 cm (72.34 g). The absence

of fish below 7.0 cm total length may be associated with the selectivity of the fishing gear rather than implying the absence of small sized individuals in Majidun creek.

The calculated growth parameter b value of 3.35 was within the limits of 2 and 4 documented by Tesch [32], Bagenal & Tesch [33] and Koutrakis & Tsikliras [34]. It is necessary to know that growth is isometric when b=3, values less or greater than 3 are allometric. The positive allometry (b=3.35) in the present study is an indication of the heaviness of the fish and by implication the fish are heavier than their lengths. The negative allometric growth means the species are lighter than their body weights. Fish with high b values are heavy for their lengths, while those with low b are lighter [26]. However, isometric growth (b=3) is an indication that the species had symmetrical growth [35, 36] and by implication the species were neither too heavy nor light for their size.

Allometric growths were reported among some tropical and subtropical water fish such as *Periophthalmus papilio* [37], *Bathygobius soporator* [38], *Mugil cephalus* [39], *Elops lacerta* [40], *Liza falcipinnis* [41] and *Polydactylus quadrifilis* [42].

The values of b in fish are affected by several factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in environmental condition [33]. Others include seasonal variability of the environment and food availability [43], sampling size and the length interval within different areas [44] or habitat suitability [45].

The LWR parameters may vary within the same species due to feeding, reproduction and fishing activities [46], environmental changes, individual metabolism, sexual maturity and age [47]. High correlation coefficient (r^2=0.97) implies that the fish's lengths and weights were growing proportionately.

Condition factor (K) is an indication of the state of the fish, whether healthy or unhealthy, starved or well fed, spawning or spent [48]. In this study, higher values were observed among the females than males (Table 5). Values of K changes according to morphology, sex, age, reproductive state associated with gonadic maturity stages variations and varies from species to species [26, 49]. Variations in K may also be indicative of food abundance, adaptation to environment and gonadal development of fish [50]. Low K means the fish are light for their lengths and indication of low feeding intensity and spawning activity. High K value is an assumption of high feeding intensity and gradual increase in accumulated fat that also suggests preparation for a new reproductive period [51].

A sex ratio of 1 male:0.72 female recorded in the present study was a departure from the expected 1male:1female. Sex ratios in favour of male were reported in *Bathygobius soporator* [38], *Elops lacerta* [40] and *Polydactylus quadrifilis* [42] *Chrysichthys walkerii* [52]. These departures may be attributed to:

- Ecological or genetical factor or both. Male fish usually predominate in the young fish because they mature earlier but live less long [53]. Females are also suspected to migrate away from the spawning grounds more rapidly than the male counterparts [54].
- Sex reversal where some females reversed or changed to male may be suspected at a stage in the life history of this species.

Sex ratio where males are dominant may not be too well as reproductive strategy because small number of females will be involved in reproduction. Sex ratio could be influenced by the availability of food [53], when food is abundant, females predominate, with the situation inverting in regions, where food is limited. Feeding activity will influence metabolism through hormonal activity, resulting in changes in production of individuals of a given sex.

Importantly, 22 other fish species comprising 8 orders from 18 families, 20 genera and 23 species of bony and shell fishes were encountered in Majidun creek. These included *Chrysicthys nigrodigitatus*, *C. aluuensis*, *Trachinotus teraia*, *Sardinella aurita*, *S. maderensis*, *Elops lacerta*, *Eleotris senegalensis*, *E. vittata*, *Eucinostomus melanopterus*, *Pomadasys peroteti*, *Psettias sebae*, *Mugil cephalus*, *Pseudolithus elongatus*, *Scomberomorus tritor*, *Bathysolea lactea*, *Sphyraena afra*, *Sierrathrissa leonensis*, *Callinectes pallidus*. *Hydrocynus forskalii*, *Sarotherondon melanotheron, Schilbe intermedius, Plesiopenaeus edwardsianus*. This suggests that natural aquatic environment houses a variety of aquatic lives.

CONCLUSION

Conclusively, the present study had examined a small population of *C. hippos* and provided first documented information on its abundance, morphometric measurements, length frequency distribution, length weight relationship, condition factor and sex ratio in Majidun Creek, Lagos, Nigeria. In furtherance of the present study, we have embarked on a research programme on the assessment of fish assemblage of this Creek.

ACKNOWLEDGEMENT

Authors acknowledge assistance of the staff of fisheries research laboratory, Lagos State University and Nigeria Meteorological Centre, Oshodi, Lagos, Nigeria.

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