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Some biological aspects of *Oreochromis niloticus* and *Oreochromis aureus* caught by trammel nets from El-Salam Canal, Egypt

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ABSTRACT

This preliminary study is the first concerning length-weight, condition factor, relative condition factor and length-girth relationships of two tilapia fish (*Oreochromis niloticus and Oreochromis aureus*) caught by trammel nets from El-Salam Canal. The results of length weight relationship showed slightly negative asymmetric growth for both species. The average of condition factor (K) was 1.70 (±0.12), and 1.72 (±0.14) for *O. niloticus* and *O. aureus*, respectively. The relative condition factor (K_n) averaged 1.00 (±0.05) for *O. niloticus* and 1.01 (±0.04) for *O. aureus*. These values suggested a good condition for these two species. The values of exponent(b)oflength-girth relationshipsrangedfrom 0.722 for *O. aureus* to 0.823 for *O. niloticus*.These results may be helpful for the fishery and biological management of the two species.

INTRODUCTION

El-Salam Canal **(Fig. 1)** is one of the major agricultural land reclamation projects in Egypt, which aims to develop the Sinai lands. It brings the Nile water to the deserts of north Sinai; originating from the River Nile at 210 km on Damietta branch and running south east ca. 89.4 km. Then, it crosses the Suez Canal through a siphon to the peninsula extending 175 km eastward in North Sinai having a mixture of drainage water and the Nile water (1:1 ratio) **(Othman *et al*., 2012)**.

Trammel nets are one of the most widely used gears in traditional fisheries in Egypt. They are similar to those used in Lake Manzala and for a detailed technical feature of trammels; it's referred to **El-Bokhty (2017)**. Because of the nature of its construction, a trammel net is able to catch both small sized and big sized fish, so the catching efficiency is relatively higher than gillnets **(Koike & Matuda, 1988)**.

Length-weight relationship studies of any fish species is a pre requisite for the study of its population **(LeCren, 1951)**. It gives information on stock composition, size increment, growth patterns and wellbeing of the fish **(Fafioye & Oluajo, 2005)**. This relationship is a useful tool in fishery assessment that helps in predicting weight required in yield assessment from length **(Garcia *et al.,* 1998)** and when comparing life history and morphology of fish population belonging to different regions, as well as studying ontogenetic allometric changes in fish species **(Hossain, 2010)**. According to **(Pauly, 1984)**, it was also possible to stabilize taxonomic characteristics of a species by mere dependence on length-weight relationships.

The condition factor (K) of a fish reflects physical and biological circumstances and fluctuations by interaction among feeding conditions, parasitic infections and physiological factors **(Le Cren, 1951)**. It also indicates the changes in food reserves and therefore an indicator of the general fish condition. **D'Ancona (1936)** pointed out that, the coefficient of condition varies with the state of gonadal maturity, months, and season and possibly with age.

The relative condition factor (Kn) is an important additional biometric tool derived from LWRs **(Le Cren, 1951)**. The relative condition factor measures the deviation of an organism from the mean weight in a given sample in order to assess the suitability of a given aquatic environment for fish growth **(Yilmaz *et al.*, 2012; Mensah, 2015)**. General fitness for fish species is assumed when Kn values are equal to or close to 1.

Fish swimming capability and condition are geatly related to body length and girth length. The body length and girth parameters detected if a gape-limited predator can ingest a special fish, thus elucidating predator–prey relationships and the ecological situation of fishes within the food webs in which they are inserted **(Hambright, 1991; Pauly, 2000; Stergiou & Karpouzi, 2003)**.

The size selectivity of nets are based on length-girth data, beside other biological factors (such as fish behavior) and technical features like fishing practices, gear structure and measurements.

Some scientists have been interested in studying the fish of the cichlid family, especially the *O. niloticus* and *O. aureus* fish in Egypt **(Bayoumi & Khalil, 1988; Abdel-baky & El-Serafy, 1990; Shalloof, 1991; Bakhoum, 1994; Mekkawy *et al.*, 1994; Soliman *et al.*, 1998; Abdalla & Talaat, 2000; Bakhoum & Abdallah, 2002; Khallaf *et al.*, 2003; Moussa, 2003; Mehanna, 2004 & 2005; El-Bokhty, 2006; Ibrahim *et al.*, 2008; Mahmoud & Mazrouh, 2008; Authman *et al.*, 2009; Shalloof & El-Far, 2009; Hassan & El-Kasheif, 2013; Mahmoud *et al.*, 2013; Saeed, 2013; El-Bokhty & El-Far, 2014 a&b), Shalloof & El- Far, 2017; Khallaf *et al.*, 2019** and **Mehanna *et al.*, 2020).**

The current investigation is the first study regarding the relationships of length-weight, Fulton and relative condition factors, and body length-girth relationships of *Oreochromis niloticus* and *Oreochromis aureus*. It aimed to evaluate the biological status and fitness of these species caught by trammel net from El-Salam Canal.

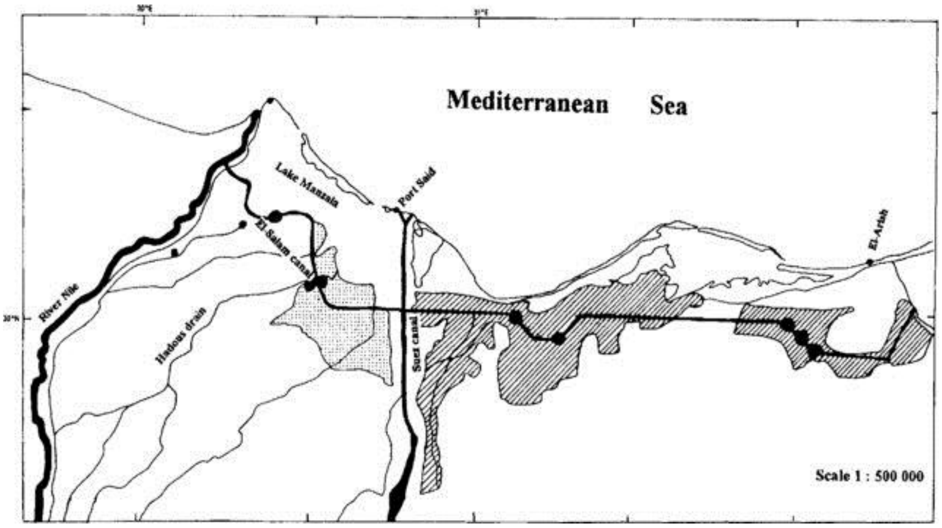

Fig. (1). El-Salam Canal (ca. 88 km between Suez Canal and Damietta branch of the Nile) **(after Serag & Khedr, 2001)**

MATERIALS AND METHODS

Fish samples were collected during autumn 2018 from commercial trammel nets used in El-Salam Canal. Fish were separated to the different species and for each fish; the following measurements were recorded. The fish total length was measured using measuring tape to the nearest millimeter and body weight to the nearest gram was recorded using mono-pan balance and girth was measured in front of the first dorsal fin .

The length weight relationship of fish is usually expressed according to **Le-Cren (1951)** by the equation:

$$W = a\,L^{b}$$

Where (W) is fish body weight (g), (L) is total fish length (cm), A logarithmic transformation was used to make the relationship linear as:

$$\text{Log}(W) = \text{Log}(a) + b\,\text{Log}(L).$$

The (a) is representing the intercept and (b) is the slope of the relationship. The coefficient of determination (R^2) is an indicator of the quality of this regression. The value of (b) delivers information about the fish growth type if it will be isometric or allometric. The Minitab 18 software was used to test the significance of the relationship.

The condition factor (K) was calculated by **Fulton's (1902)**.

$$K = 100W/L^{3}$$

Where W is fish body weight (gm), (L) is total fish length (cm). Relative condition factor (K_n) calculated according to **(Le Cren, 1951)**

$$K_n = W_o/W_c$$

Where (W_o) is the observed weight, and (W_c) is the calculated weight. Good growth condition of the fish is deduced when $Kn \geq 1$, while the organism is in poor growth condition compared to an average individual with the same length when $Kn < 1$.

Most of fish species showed a linear relationship between girth G and length L in the form of:

$$G = a + b*L \qquad \text{(Santos } et\ al.\text{, 2006)},$$

Where (a) and (b) are coefficients determined by regression.

The relationships in the present work were tested for significance by using Minitab 18 software.

RESULTS AND DISCUSSION

In the present work the length of *O. niloticus* specimens ranged between 11.3 and 21.5 cm but those of *O. aureus* were ranged from 9.8 to 18.5 cm. The weights of *O. niloticus* ranged from 24 to 165 g. while the *O. aureus* weight ranged from 18 to 93 g. If the length growths in equal proportions with body weight for constant specific gravity, then the fish are said to show isometric growth. The coefficient of regression for isometric growth is equal ‘3’ and values greater or lesser than ‘3’ designate allometric growth **(Gayanilo & Pauly, 1997)**.

The logarithmic transformation of the length weight relationship of *O. niloticus* and *O. aureus* gave a straight line **(Fig. 2)**. The value of (b) is 2.793 and 2.686 for *O. niloticus* and *O. aureus* respectively. Length-weight relationships were highly significant at $p < 0.05$ and showed that about 97 % (R^2=96.9) of *O. niloticus* and for O. *aureus* was 94 % (R^2=94.3) changes in the fish total weight can be described by the following linear regression equation as:

$$\log_{10}(W) = -1.519 + 2.793 \log_{10}(L) \quad \text{for } O.\ niloticus$$

$$\log_{10}(W) = -1.417 + 2.686 \log_{10}(L) \quad \text{for } O.\ aureus$$

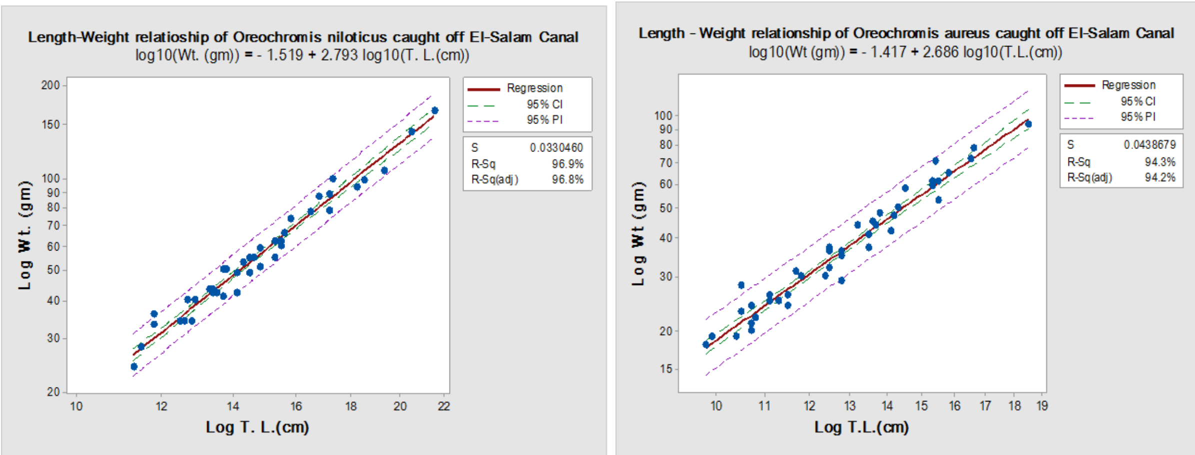

Fig (2). The relationships between weight and length of *O. niloticus* and *O. aureus* caught by trammel net from El-Salam Canal

According to **(Ricker, 1975)** the growth, of *O. niloticus* and *O. aureus* caught by trammel net from El-Salam Canal during 2018 were slightly negative asymmetric. More early, **Frost (1945)** explained that the deviations in the fish shape, physiological variations hydrological environmental conditions, different food availability during life and biological span, growth increment or break in growth can all impact the growth exponent (b). The variances in *b*-values can also be attributed to the combination of one or more of the following reasons: (*a*) differences in the number of specimen examined (*b*) area/season effect and (*c*) differences in the observed length ranges of the specimen caught **(Moutopoulos & Stergiou, 2002)**.

Fulton's coefficient of condition (K) is another factor showing the mathematical relation between length and weight of a fish. It shows the degree of robustness or wellbeing of fish, and its value may change according to age, length, weight, sex, state of maturity…. etc.

Concerning Fulton's condition factor (K), it varied between 1.46 and 1.87 with an average of 1.70 (±0.12) for *O. niloticus*. While for *O. aureus* , it ranged between 1.47 and 1.94 with an average of 1.72 (±0.14) **(Table, 1** and **Fig. 3)**.

Table (1): The condition factor (K) and relative condition factor (K_n) of *O. niloticus* and *O. aureus* caught by trammel net from El-Salam Canal

L	*O. niloticus*		*O. aureus*	
	K	K_n	k	K_n
9	--	--	1.94	1.04
10	--	--	1.90	1.04
11	1.87	1.02	1.76	0.99
12	1.78	0.99	1.62	0.94
13	1.77	1.00	1.72	1.02
14	1.72	0.99	1.69	1.02
15	1.71	1.00	1.66	1.03
16	1.77	1.05	1.67	1.05
17	1.77	1.06	--	--
18	1.55	0.93	1.47	0.96
19	1.46	0.89	--	--
20	1.64	1.01	--	--
21	1.66	1.04	--	--
Avrerage	**1.70**	**1.00**	**1.72**	**1.01**
± SD	**0.12**	**0.05**	**0.14**	**0.04**

The deviation of the relative condition factor (K_n) from one provides information regarding differences in food availability and the consequences of physical and chemical traits on the life cycle of fish species **(Le Cren, 1951)**. According to length group (K_n) values of *O. niloticus* in the current study fluctuated between 0.89 and 1.06 with an average 1.00 (±0.05) and the corresponding values of *O. aureus* ranged between 0.94 and 1.05 with an average 1.01 (±0.04) **(Table, 1** and **Fig. 4)**. A number of reasons can influence the growth status of fish such as reproductive activities, food availability, as well as environmental and habitat factors **(Morato *et al.*, 2001)**.

Bagenal & Tesch (1978) stated that if the condition factor k was ≥ 0.5, then the fish is in a good situation. However, there is no study was undertaken on the physical and chemical parameters of the canal to confirm this. Therefore, the results suggest a good condition for the two species.

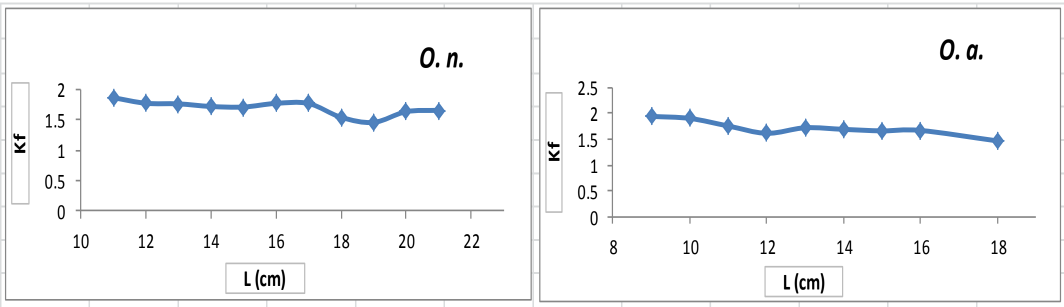

Fig. (3): Condition factors (K) of *O. niloticus* and *O. aureus* caught by trammel net from El-Salam Canal

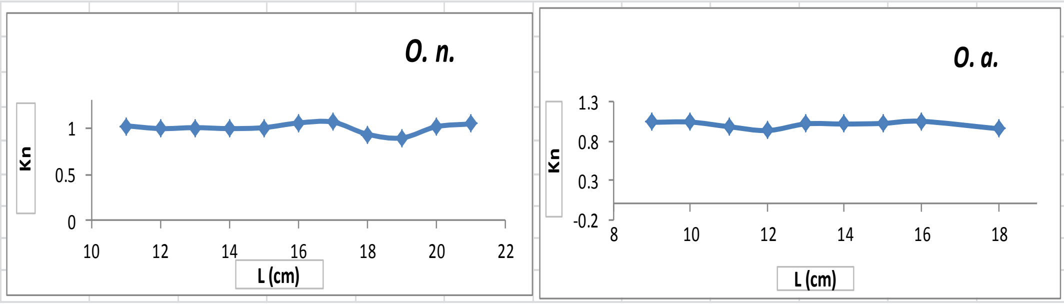

Fig. (4): Condition factors (K_n) of *O. niloticus* and *O. aureus* caught by trammel net from El-Salam Canal

Several studies have been carried out on weight - length relationship, condition factors, and relative condition factors of *O. niloticus* and *O. aureus* in Egyptian waters. Manzala Lake **(Bayoumi & Khalil, 1988; Abdel-baky & El-serafy, 1990; Shalloof, 1991; Soliman *et al.*, 1998; Bakhoum & Abdallah, 2002; El-Bokhty, 2006** and **Mehanna *et al.*, 2020)**; Burullus Lake **(Moussa, 2003)**; Mariut Lake **(Bakhoum, 1994)**; Nasser Lake **(Mekkawy *et al.*, 1994)**,; River Nile **(Khallaf *et al.*, 2003; Mahmoud & Mazrouh, 2008; Authman *et al.*, 2009; Hassan & El-Kasheif, 2013; El-Bokhty & El-Far, 2014 b; Shalloof & El- Far, 2017** and **Khallaf *et al.*, 2019)**,; Nozha Hydrodom **(Mahmoud *et al.*, 2013)**; Lake Edku **(Abdalla & Talaat, 2000** and **Saeed, 2013)**; Abu- Zabal Lakes **(Ibrahim *et al.*, 2008** and **Shalloof & El- Far, 2009)** and Wadi El-Raiyan Lakes **(Mehanna 2004 & 2005)**. **Table (2)** showed different results from previous studies on *O. niloticus* and *O. aureus* in different places in Egypt.

Fish body girth can be determined by three techniques: (a) through the vertical eye diameter (G_1), (b) behind the cover of gill (G_2) and (c) in front of the first dorsal fin (G_3). These three types of girth determine the probability of various kinds of capture by a fishing gear, evaluated by G_1 in the case the fish are tangled, by G_2 once fish are gilled and by G_3 when fish are wedged **(Reis & Pawson, 1999; Stergiou & Karpouzi, 2003)**. The outcomes of the present work indicated that, the length-girth relationships of the two studied species are principally useful for trammel net fisheries managing in El-Salam Canal.

Table (2): Length-weight relationships regression parameters (a and b), condition factor (K), and relative condition factor (K_n) of *O. niloticus* and *O. aureus* from different locations in Egypt.

Location	Region	Species	a	b	Kf	Kn	Author
El-Salam Canal		*O. niloticus*	-1.519	2.793	1.7	1	Present study
		O. aureus	-1.417	2.686	1.72	1.01	
Lake Manzala		*O. niloticus*	0.0143	3.08			Mehanna *et al.*, 2020
			0.01745	3.0104			El-Bokhty, 2006
		O. aureus	0.01332	3.0939			
	Southwest(A)	*O. niloticus*	-1.1537	2.748	1.628		Bakhoum and Abdallah, 2002
		O. aureus	– 1.6910	2.8715	1.467		
	Southeast (B)	*O. niloticus*	-1.7765	2.953	1.321		
		O. aureus	– 2.0475	3.199	1.45		
		O. niloticus	0.0424	2.704		1.01	Soliman *et al.*, 1998
		O. aureus	0.0567	2.561		1.009	
		O. niloticus	-1.68	2.98	1.96		Bayoumi and Khalil, 1988
		O. aureus	-1.63	2.9	1.93		
		O. niloticus	-1.82	3.0282		0.98	Abdel-baky and El-Serafy, 1990
Lake Burullus	Eastern	*O. niloticus*	0.0163	2.8944	1.2		Moussa, 2003
		O. aureus	0.0179	2.9036	1.39		
	Middle	*O. niloticus*	0.0139	3.0042	1.42		
		O. aureus	0.0164	2.9471	1.41		
	Western	*O. niloticus*	0.0091	3.294	2.06		
		O. aureus	0.0153	2.9864	1.53		
Lake Mariut	Southeast basin	*O. niloticus*	-1.71	2.932	1.643		Bakhoum, 1994
		O. aureus	-1.4289	2.6258	1.498		
	Lake proper	*O. niloticus*	-1.196	3.138	1.551		
		O. aureus	-1.7419	2.8514	1.262		
Lake Edku		*O. niloticus*	0.017	3.033			Abdalla and Talaat, 2000
		O. aureus	0.0326	2.753			
		O. niloticus	-1.5217	2.9	1.72		Saeed, 2013
		O. aureus	-1.3935	2.76	1.53		
Wadi El-Raiyan Lakes	1st lake	*O. niloticus*	0.021	2.982			Mehanna, 2005
	2nd lake		0.016	3.077			
		O. aureus	0.0122	3.109			Mehanna, 2004
River Nile	Bahr Shebeen	*O. niloticus*	0.0427	2.77	2.07		Khallaf *et al.*, 2003
	Nile Canal		0.0214	3.1971			Khallaf *et al.*, 2019
	Beni Suef		0.0377	2.792	1.03 to 1.9	0.99 to 1.93	Hassan and El-Kasheif, 2013
	Rosetta Branch		0.02397	2.922			El-Bokhty and El-Far, 2014b
			0.018	3.008	1.84		Mahmoud and Mazrouh, 2008
		O. aureus	0.025	2.872	1.79		
	Damietta Branch	*O. niloticus*	0.028	3.075			Authman *et al.*, 2009
			0.018	3.017	1.919		Shalloof and El- Far,2017
		O. aureus	0.081	2.42	1.759		
Nozha Hydrodom		*O. niloticus*	0.027	2.909	2.05		Mahmoud *et al.*, 2013
		O. aureus	0.022	2.973	1.96		
Abu- Zabal		*O. niloticus*	0.089	2.403	1.71		Shalloof and El- Far, 2009
		O. aureus	0.179	2.108	1.66		
		O. niloticus	0.028	2.859	1.86		Ibrahim *et al.*, 2008
		O. aureus	0.044	2.67	1.89		

Estimation of girth from length **(Fig. 5)** measurements using the resultant length-girth relationships are significant because length is easier to attain and is more readily accessible. These relationships, in combination with the present length data, can be essential tools in the management of trammel net fisheries. The exponent (b) ranged from 0.722 (R_{sq}= 78.7%) for O. *aureus* to 0.823 (R_{sq}= 91.7%) for *O. niloticus*. the length- girth relationships were found to be as the following:

$$G = -0.5129+0.8228\ L \qquad \text{for } O.\ niloticus$$

$$G = 0.4396+0.7222\ L \qquad \text{for } O.\ aureus$$

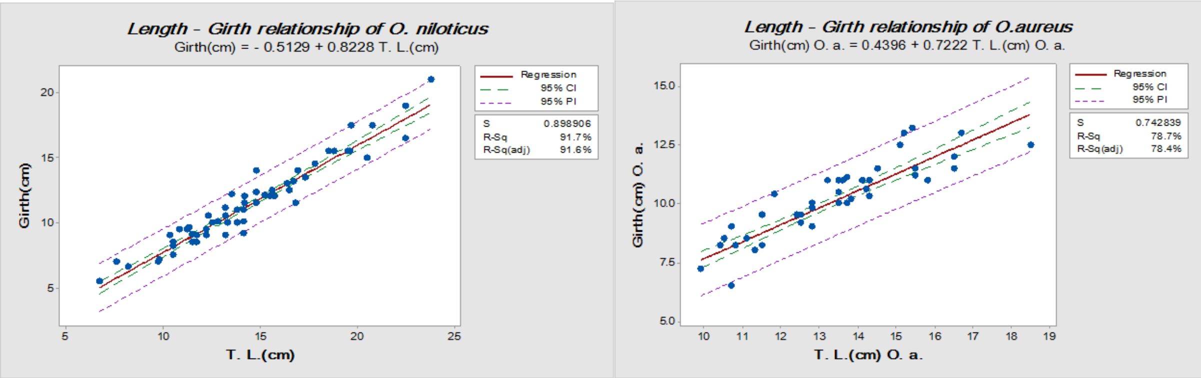

Fig (5): The length- girth relationship of *O. niloticus* and *O. aureus*, caught by trammel net from El-Salam Canal during 2018.

CONCLUSION

The growth pattern of *O. niloticus* and *O. aureus* caught by trammel net from El-Salam Canal during 2018 was slightly negative asymmetric. The two species have a good growth condition. The relationship between both length and girth of the studied two species in this work are mostly beneficial for trammel net fisheries management in El-Salam Canal. More investigations are needed to study the effect of water mixing between Nile water and agricultural drains on these fish traits.

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