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Original

Somebody relationships in 15 populations of two Nile Cichlids in the Sudan.

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Abstract

Background:
The objective of this work is to quantify the body weight, body depth and standard length relationship of *Oreochromis niloticus*, *Sarotherodon galilaeus* from the Nile and its tributaries **to find out the population of best traits.**

Methods: Fish body weight was recorded to 0.1gm using an electronic field balance. The standard length and body depth were measured using a measuring tape to the nearest cm.

Results: The standard length-body weight relationship of *O. niloticus* and *S. galilaeus* 15 populations, was significant ($p<0.05$ to$p<0.001$), except for *S. galilaeus* populations from Wad Medani and Shendi ($p>0.05$). The growth mode of the different populations of *O. niloticus* and *S. galilaeus* ranged from negative allometric, isometric to positive allometric.The standard length-body depth relationship of *O. niloticus* and *S. galilaeus* was mostly significant ($p<0.05$ to $p<0.001$

Conclusions:

The study concluded that there is a relatively high level of polymorphism and genetic diversity within and between *O. niloticus* and *S. galilaeus* and a comparatively high overall interspecies pair wise divergence. The population of *O. niloticus* from Al Kalakla is quite different from other populations, and thus can be recommended for improvement of other tilapias varieties.

Keywords:*Body relations***,** *Oreochromis niloticus, Sarotherodon galilaeus.*

Introduction

In fishery biology the correlated length-weight relationship is very important for proper exploitation and management of wild and aquaculture populations of fish species [1, 2, 3] in addition to determining the impact of stress of water pollution on the fish's body condition [3]. Regression analysis of these parameters yields an equation with an intercept (a), slope (b) and correlation (r) values. A significantly correlated determined from regression coefficient (r) or coefficient of determination (R^2) can be used with high accuracy to estimate the body weight of a fish species at a given length [4]. This relationship enables assessing the well-being of individuals and differences between separate populations of the same species [5] and compare their growth [6].

According to [4, 7] the b values in length-weight relationships tells the growth pattern of fish species. The value of b indicates an isometric growth when equal or close to 3 (fish becomes more full-bodied with increasing length). When b is far less or greater than 3, growth in the fish is allometric (the fish becomes thinner with increase in length).

Body shape in fish can evolve in response to a variety of evolutionary trait such as genetic makeup [8] predation, competition and environmental factors acting on populations [9] linking morphology to species interaction [10]. The body depth in fishes determines their susceptibility to predator, attraction of mate, swimming performance, habitat specialization and phenotypic traits [11].

The objective of this work is to quantify the body weight, body depth and standard length relationship of *Oreochromis niloticus*, *Sarotherodon galilaeus* from the Nile and its tributaries.

Material and Methods

Source of fish.

Fifteen populations of *O. niloticus* and *S. galilaeus* were collected from different site (Table 1). Collection was made by purchasing highly fresh specimen from commercial fishers operating in the area. Fish were kept chilled fish in an ice parked plastic container.

Morphometric characters

The body weight (BW) was recorded to the nearest 0.1g using an electronic field balance. The standard length (SL): distance from tip of snout to the caudal fin base at articulation, and the body depth (BD): maximum vertical depth of the body depth situated in between anterior base of dorsal fin and origin of pelvic fin. Measured were recorded to the nearest cm using a measuring tape.

Statistical analysis

Correlation analysis between the measured parameters was done by Microsoft Excel sheet programme.

Table 1. Sample sites *O. niloticus* and *S. galilaeus* populations and abbreviations**.**

Site	Locations	Coordinates		Number of specimens	
		N	E	*O. niloticus*	*S. galilaeus*
Blue Nile	Ad Damazin	11°47'	34°21'	19	38
	Sennar	13°33'	33°35'	31	31
	Wad Madani	14°23'	33°30'	8	6
White Nile	Gitaina	14°51'	32°22'	40	38
	Jebel Aulia	15°22'	32°52'	39	25
	Al Kalakla	15°46'	32°48'	37	35
Rive Nile	AL Mawrada	15°64'	32°48'	40	0

	Shendi	16°41'	33°26'	38	6

Results

The standard length-body weight relationship of *O. niloticus* and *S. galilaeus* 15 populations, was observed to be significant ($p<0.05$ to $p<0.001$, Table 2 and Figs. 1 to 6), except for *S. galilaeus* populations from Wad Medani and Shendi ($p>0.05$, Table 2). The correlation coefficient ranged from $r=0.764$ to 0.978 (Table 2). This indicates that in 8 populations of *O. niloticus* and 5 populations of *S. galilaeus* the body weight of the fish species could be estimated with a high degree of accuracy from known standard lengths. The growth pattern of the different populations of *O. niloticus* and *S. galilaeus* ranged from negative allometric, isometric to positive allometric, but mostly negatively allometric (Table 2).

Table 2. Standard length body weight relationships in 15 populations of *O. niloticus* and *S. galilaeus*

Site	Species	Regression equation	r-value	p-value	Growth
Ad Damazin	*O. niloticus*	$Y=0.1218X^{2.4761}$	0.876	$p<0.001$	-ve allometric
	S. galilaeus	$Y=0.0301X^{3.0813}$	0.809	$p<0.001$	Isometric
Sinnar	*O. niloticus*	$Y=0.0209X^{3.1167}$	0.898	$p<0.001$	≈ isometric
	S. galilaeus	$Y=0.0384X^{2.7786}$	0.978	$p<0.001$	-ve allometric
Wad Madani	*O. niloticus*	$Y=0122X^{2.5969}$	0.774	$p<0.05$	-ve allometric
	S. galilaeus	$Y=0.0005X^{4.5584}$	0.737	$p>0.05$	+ve allometric
Getina	*O. niloticus*	$Y=0.4553X^{2.8508}$	0.932	$p<0.001$	≈ isometric
	S. galilaeus	$Y=0.0678X^{2.9694}$	0.764	$p<0.001$	≈ isometric
Jebl Aulia	*O. niloticus*	$Y=0.1764X^{2.3696}$	0.912	$p<0.01$	-ve allometric
	S. galilaeus	$Y=0.1771X^{2.4795}$	0.755	$p<0.001$	-ve allometric
Alkalakla	*O. niloticus*	$Y=0.0563X^{2.7768}$	0.926	$p<0.01$	-ve allometric
	S. galilaeus	$Y=0.2617X^{2.2311}$	0.852	$p<0.001$	-ve allometric
Al Morada	*O. niloticus*	$Y=1.7348X^{1.3935}$	0.824	$p<0.01$	-ve allometric
Shendi	*O. niloticus*	$Y=0.1446X^{1.3767}$	0.885	$p<0.01$	-ve allometric
	S. galilaeus	$Y=0.2428X^{2.1502}$	0.864	$p>0.05$	-ve allometric

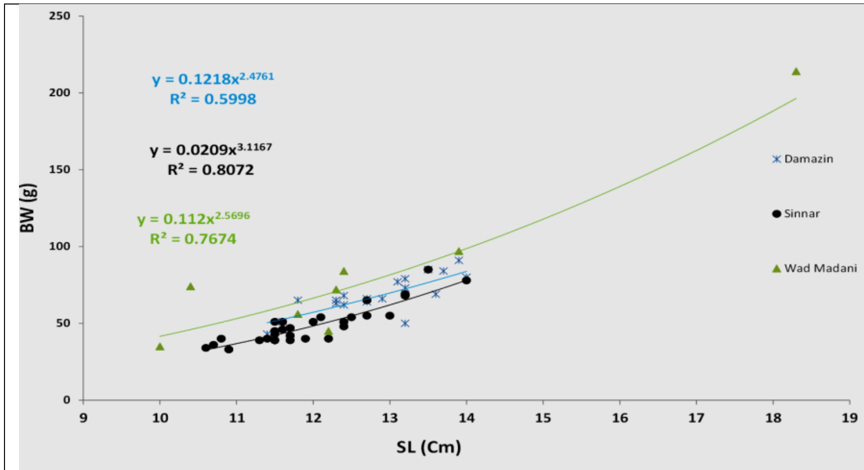

Fig 1. Standard length body weigh relationship of *O. niloticus* from Blue Nile

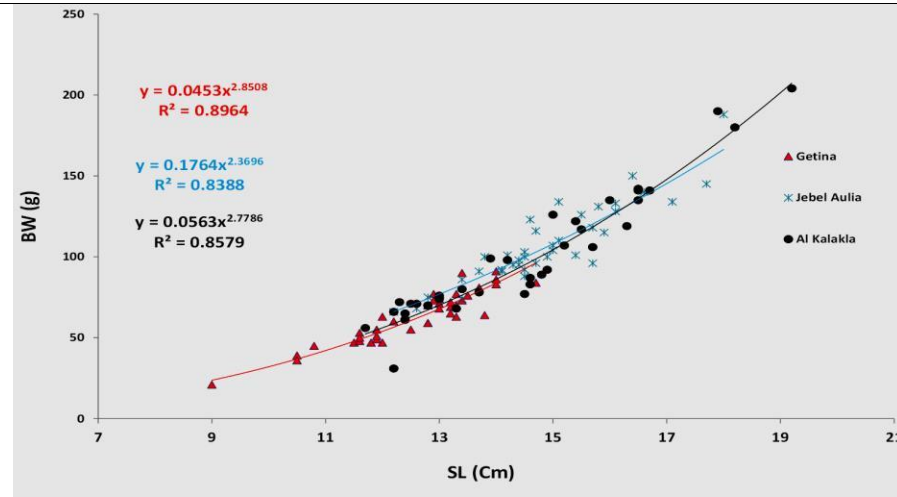

Fig 2. Standard length body weigh relationship of *O. niloticus* from White Nile**.**

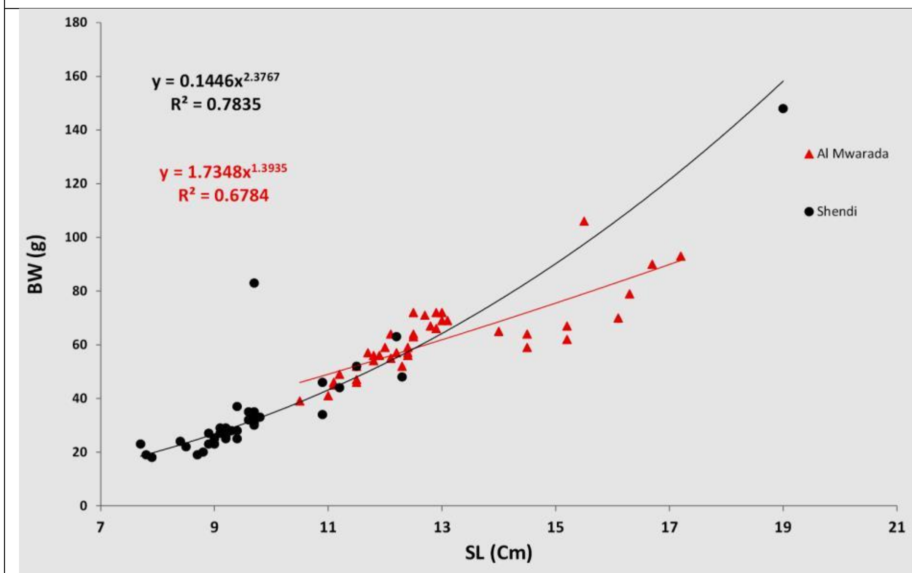

Fig 3. Standard length body weigh relationship of *O. niloticus* from

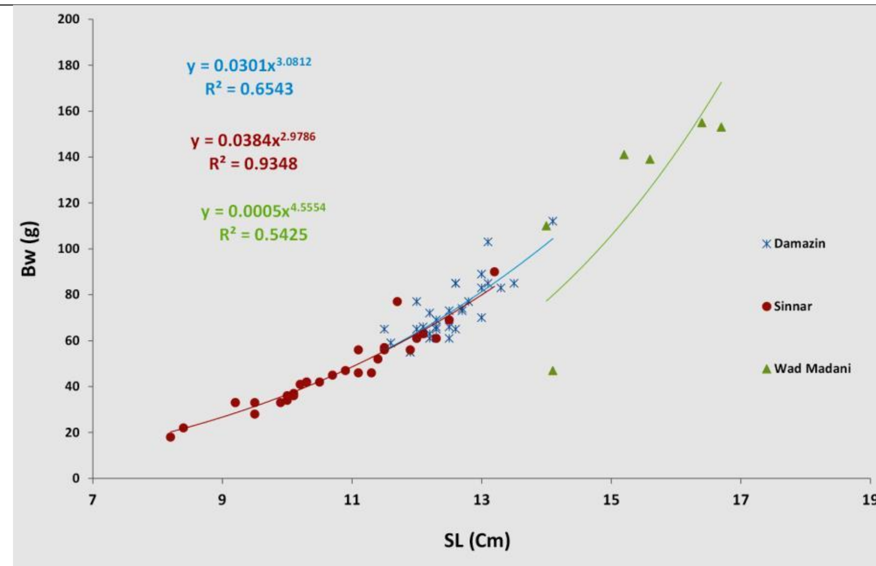

Fig 4. Standard length body weigh relationship of*S. galilaeus* from Blue Nile.

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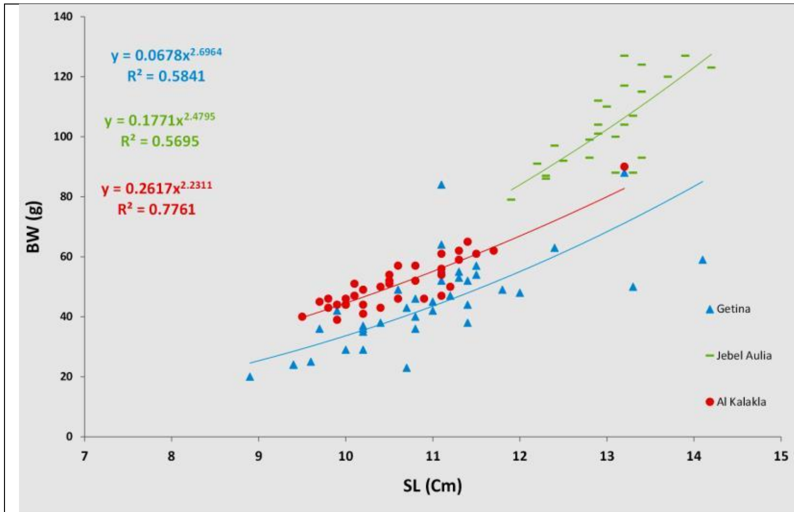

Fig 5. Standard length body weigh relationship of *S. galilaeus* from the White Nile.

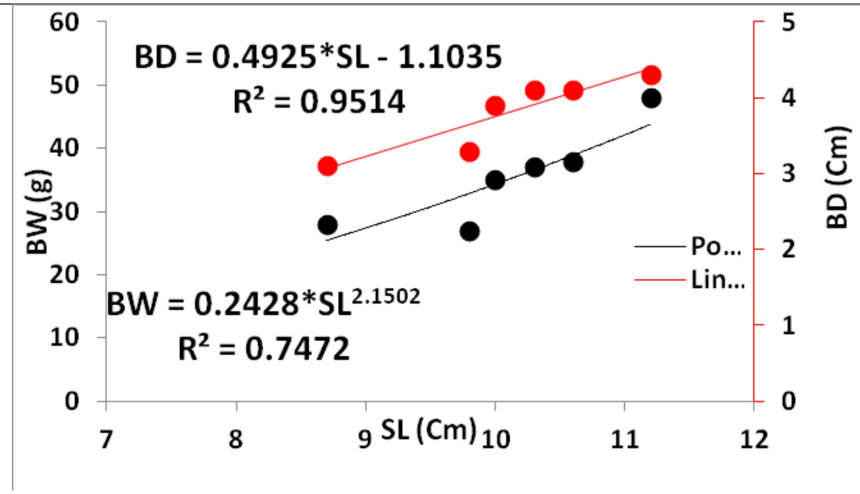

Fig 6. Standard length body weight of *S. galilaeus* from the Nile.

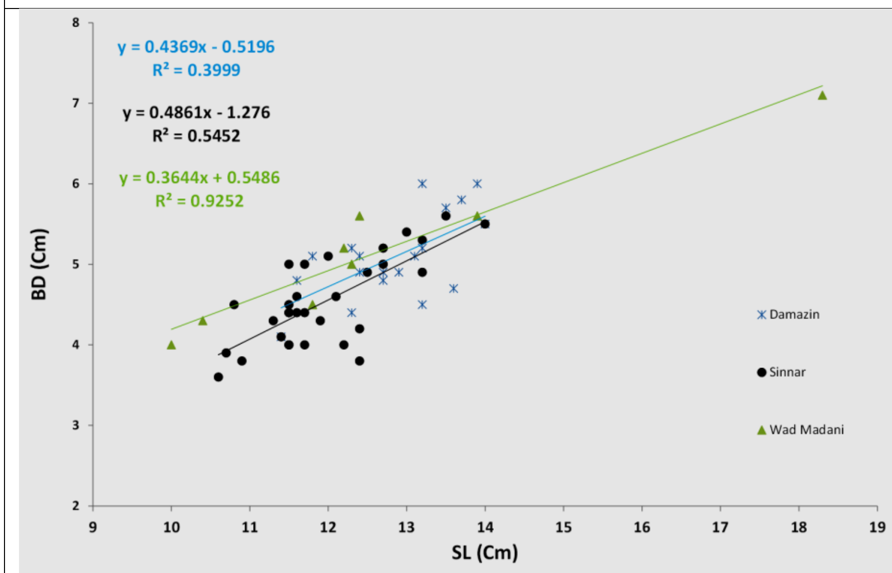

Fig 7. Standard length body depth relationship of *O. niloticus* from the Blue Nile.

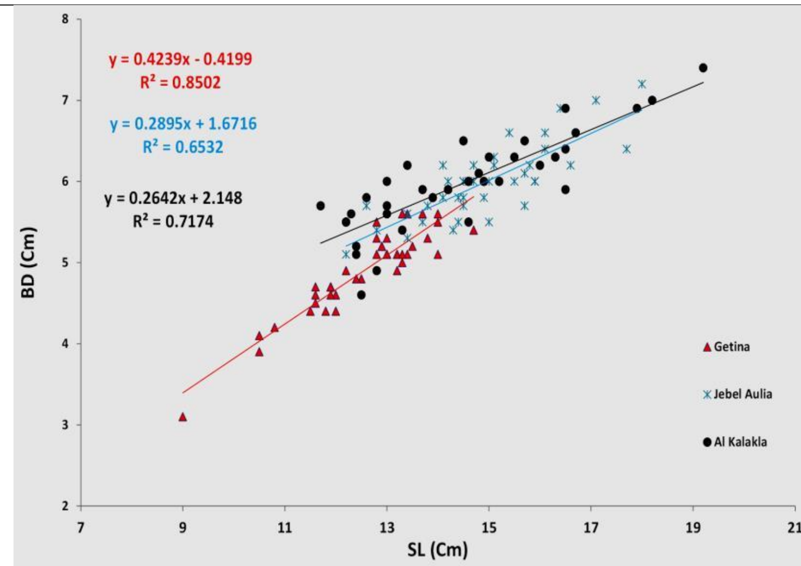

Fig 8. Standard length and body depth relationship of *O. niloticus* from the White Nile.

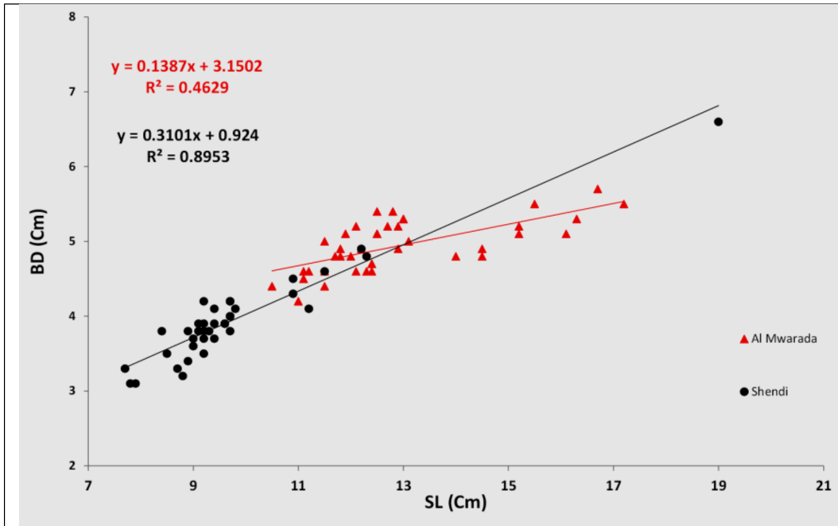

Fig. 9. Standard length body depth relationship of *O. niloticus* from the Nile.

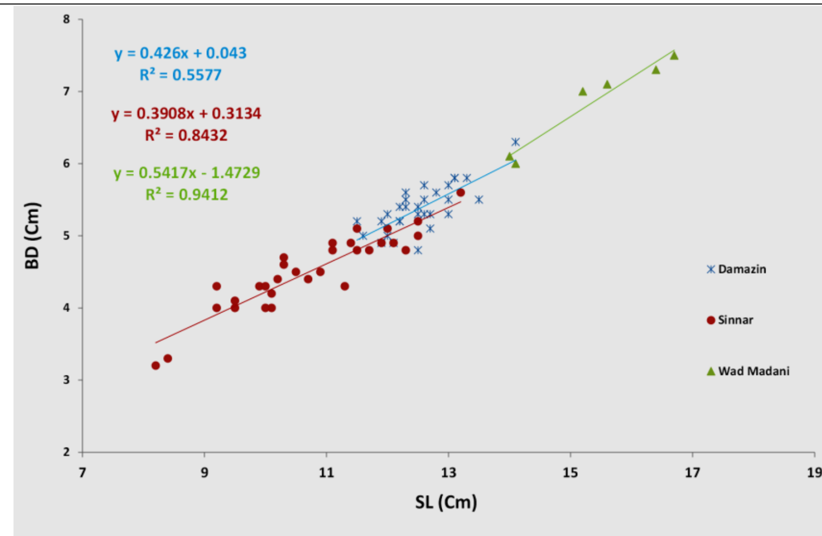

Fig. 10. Standard length body depth relationship of *S. galilaeus*Blue Nile.

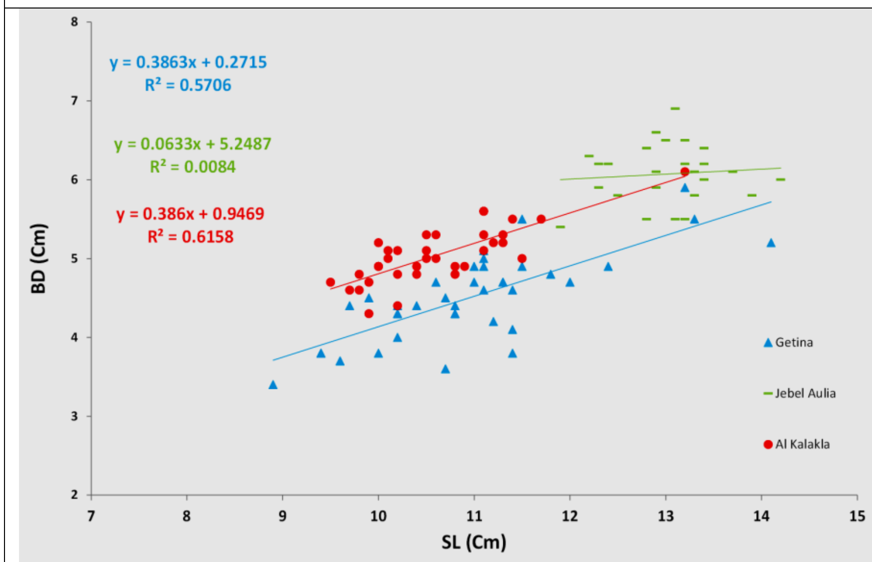

Fig. 11. Standard length body depth relationship of *S. galilaeus*White Nile**.**

The standard length-body depth relationship of *O. niloticus* and *S. galilaeus* 15 populations, was observed to be significant ($p<0.05$ to $p<0.001$, Table 3 and Figs.7 to 11), except for *S. galilaeus* population from Jebel Aulia ($p>0.05$, Table 3). The correlation coefficient ranged from r=0.760 to 0.931 (Table 3).

Table 3. Standard length body depth relationships in 15 populations of *O. niloticus* and *S. galilaeus*

Site	Species	Regression equation	r-value	Significance
Ad Damazin	*O. niloticus*	$Y=4.8109X^{1.6268}$	0.877	$p<0.001$
	S. galilaeus	$Y=1.3998X^{2.3472}$	0.818	$p<0.001$
Sinnar	*O. niloticus*	$Y=3.812X^{1.6755}$	0.846	$p<0.001$
	S. galilaeus	$Y=0.7456X^{2.7238}$	0.931	$p<0.001$
Wad Madani	*O. niloticus*	$Y=1.1105X^{2.5745}$	0.854	$p<0.01$
	S. galilaeus	$Y=0.052X^{4.0186}$	0.830	$p<0.05$
Getina	*O. niloticus*	$Y=1.4419X^{2.3616}$	0.954	$p<0.001$
	S. galilaeus	$Y=1.1415X^{2.4164}$	0.875	$p<0.001$
Jebl Aulia	*O. niloticus*	$Y=1.4041X^{2.3616}$	0.828	$p<0.001$
	S. galilaeus	$Y=27.089X^{0.7381}$	0.333	$p>0.05$
Alkalakla	*O. niloticus*	$Y=0.515X^{2.942}$	0.760	$p<0.001$
	S. galilaeus	$Y=2.5781X^{1.8428}$	0.878	$p<0.001$
Al Morada	*O. niloticus*	$Y=0.855X^{2.6884}$	0.894	$p<0.001$
Shendi	*O. niloticus*	$Y=0.855X^{2.6438}$	0.882	$p<0.001$
	S. galilaeus	$Y=0.52811X^{-1.5337}$	0.917	$p<0.001$

Discussion

The standard length-body weight relationship of the 15 populations *O. niloticus* and *S. galilaeus*, was significant ($p<0.05$ to $p<0.001$, except for *S. galilaeus* populations from Wad Medani and Shendi ($p>0.05$). The correlation coefficient ranged from r=0.764 to 0.978. Shalloof and El- Far [12] reported highly correlated growth equations in *O. niloticus* (r=0.979); *Orechromis aureus* (r=0.983), *Tilapia zillii* (r= 0.986) and *S. galilaeus* (r= 0.978) in Abu- Zaabal Lakes, Egypt. Basohan *et al.* [13] derived a highly correlated (r=0.850) standard length-body weight equation for *O. niloticus* from Ibiekuma stream. Kara [14] worked on the same species in Roseris Dam reservoir and recorded r^2 = 0.996 and 0.996 for males and females *O. niloticus* respectively. Nigeria. Atama *et al.* [15] studied this relationship in *O. niloticus*, *Hemichromis bimaculatus*, *T. zilli*, *Hemichromis fasciatus* and *Tilapia mariae* from Anambra River, Nigeria and reported highly correlated relations (r= 0.771-0.966). Adite *et al.* [2] studied the linear regression between total length and body weight of *O. niloticus* and *S. galilaeu* fishes at LakeToho, South Benin in its fresh water and the ecotonal coastal zone. They reported r=0.990 and 0.990 for *O. niloticus*, and r=0.980 and 0.990 for *S. galilaeus*, respectively. From Lower Benue River, Nigeria, Azua [16] found a strong relationship between log of body weight and standard length with r value of 0.932 in *O. niloticus* while a weak relationship was obtained in *Tilapia zilli* with r value of 0.298. Famoofoand Abdul [17] found highly correlated (r=0.518-0.953) length-weight relationship for *S. arotherodon galilaeus*, *H. fasciatus*, *T. zilli* and *S. melanotheron* fromLekki Lagoon,Nigeria. It is apparent that the standard length-body weight relationship in the same species differs in different water bodies.

In the present study the growth of *O. niloticus* and *S. galilaeus* was isometric in Getina site and mostly negatively allometric in other sites. In Alkalakla, Almorada and Sheni the populations of both species was negatively allometric. Positive allometry with b>3 (*S. galilaeus* from Wad Medani) implies asymmetrical growth or increases in length more than in weight. Idris and Mamoud [4] reported similar observations in *labeo niloticus*. Shalloof and El-Far [12] reported negative allometric growth in *O. niloticus* (b=2.403), *O. aureus* (b=2.108), *T.* zillii (b=3.147) and *S.galilaeus* (b=2.758) in Abu-ZaabalLakes.

Laghari *et al*. [18] investigated the length-weight relationship from 500 specimen of *O. niloticus* maintained in a concrete pond and found positive allometry as b=4.55. Ibrahim *et al*. [19] from Kontagora Reservoir in Niger state recorded b-value of 2.8 for *Barilius niloticus* Cyprinids. Atama *et al*. [15] reported positive allometric growth for *H. bimaculatus* and *T. zilli* (b =3.828 and 3.210, respectively, while *H. fasciatus*, *Tilapia mariae* and *O. niloticus* exhibited negative allometric growth with b =2.667, 2.272 and 2.792, respectively. Ngodhe and Owaor-JB [20] reported that *O. niloticus* showed positive allometric growth of 3.16 an3.09 in cage culture and open waters in WinamGulf in L. Victoria. Famoofoand Abdul [17] found that *S. galilaeus* and *H. fasciatus* exhibited negative allometric growth with b=2.27 and 2.42, respectively; while *T. zilli* and *S. melanotheron* exhibited positive allometric growth with b=3.312 and 3.411, respectively. Silva *et al*. [21] reared 3,000 juvenile *O. niloticus* in three circular cages and reported isometric growth b=3.0604.

The water characteristic and/or culture media may play role in growth mode. Alex *et al*. [22] found negative allometric growth in fresh water and positive allometric growth in full strength sea water for *T. zilli*. Adite *et al*. [2] reported b-values of 2.977 and 3.007 for *O. niloticus* and 2.976 and 2.831 for *S. galilaeu* fishes in fresh water and ecotonal coastal, respectively. From Lekki Lagoon,Nigeria,and *Oreochromis urolepis*.

Little attention was given to standard length-body depth relationship. In the present study *O. niloticus* and *S. galilaeus* 14 populations, showed significant (p<0.05 to p<0.001) in the standard length-body depth relationship of *O. niloticus* and *S. galilaeus*, except for *S. galilaeus* population from Jebel Aulia (p>0.05). The correlation coefficient of both lengths ranged from r=0.760 to 0.931. Fernando *et al*. [23] reported that in Centrarcids, the standard length body depth relationship were generally good, with coefficient of determination R^2=0.764-0.998.The body depth morphology in fishes was tackled by many authors from different behavioural aspects and habitat specialization [11].

Conclusion

The study concluded that there is a relatively high level of polymorphism and genetic diversity within and between *O. niloticus* and *S. galilaeus* and a comparatively high overall interspecies pair wise divergence. The population of *O. niloticus* from Al Kalakla is quite different from other populations, and thus can be recommended it for improvement of other tilapias varieties.

Ethics Approval and Consent to Participate
Not applicable.
Human and Animal Rights
not applicable.
Consent for Publication
not applicable.
Availability of data and Materials
not applicable.
Conflict of Interest
The authors declare no conflict of interest, financial or otherwise.

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