Sahel Journal of Life Sciences FUDMA (SAJOLS)
September 2024 Vol. 2(3): 17-24
ISSN: 3027-0456 (Print)
ISSN: 1595-5915(Online)
DOI: https://doi.org/10.33003/sajols-2024-0203-03

Research Article

Assessing Length-Weight Relationships of *Anodonta anatina* in Damba Reservoir

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ABSTRACT

Bivalves are molluscs of aquatic bottom dwellers that have many ecological impacts. Most importantly, they purify the water they inhabit. They are affected by environmental, ecological, and biological factors. The current study aimed to determine the length-weight relationship (LWR) of *Anodonta anatina* in the Damba Reservoir using standard procedural methods. One hundred samples were collected using the handpicking method at four sampling stations in the reservoir over five weeks. LWR was determined using morphometric measurements with digital Vernier caliper. The highest correlation coefficient (0.9632) was recorded for the TL-W relationship. The paired variable values of total length – weight (TL-W), height -weight (H-W), width – weight (WD-W), lever length – weight (LL-W), and umbo-anterior length – width (UAL-W) showed negative allometric values, with b values <3 (1.27, 1.07, 0.85, 1.02, 0.92 respectively). These results show that growth in length (TL, H, WD, LL, and UAL) was faster than the increase in weight of *A. anatina* in the Damba Reservoir relating to poor state of wellbeing.

Keywords: Length-weight relationship; A*nodonta anatine;* Bivalve; Morphometric Measurements; Damba Reservoir

Citation: Asiru, R.A. and Adedeji, H.A. (2024). Assessing Length-Weight Relationships of *Anodonta anatina* in Damba Reservoir. *Sahel Journal of Life Sciences FUDMA,* 2(3): 17-24. DOI: https://doi.org/10.33003/sajols-2024-0203-03

INTRODUCTION

The bivalve, *Anodonta anatina* belongs to the Unionidae family of freshwater mussels that commonly occur in freshwater on all continents, except Antarctica (Graf & Cummings, 2007). They move up to some meters per day with their foot and form grooves as they travel across the bottom. The outlines of shells poking out of the sand can then be seen with paired pale siphons appearing between the valves (Shinn *et al.* 2015). All bivalve mollusks shared the characteristics of a house made of two calcareous shells. The scute - or scale-like external plates have a pronounced triangular angle.

As a bottom feeder, this mollusc uses its foot to move along the ground at the bottom of the water (Bartsch *et al.* 2013). The foot also serves as an anchor in soft or sandy sediments. By stirring the bottom sediment, the mussel can filter out nutrients from the water with its gills. It primarily feeds on organisms living at the bottom, such as small algae and cyanobacteria. However, detritus (dead plants and animal matter) may also be present on the menu. *Anodonta. anatina* like other bivalves has various ecological importance, majorly as bio-filters due to their mode of feeding. They purify water by removing organic matter and harmful organisms such as pathogenic bacteria (Miller *et al.* 2006), parasitic protists (Robertson, 2007), free-living larvae of fish trematodes (Gosling, 2003), and parasitic copepods (Molloy *et al.* 2011). As such, they reduce various aquatic diseases caused by microparasites (Burge *et al.* 2016). Despite their vast importance, their larvae (glochidia) have an ectoparasitic lifestyle in the gill chambers of fish (Hinzmann *et al.* 2013; Labecka & Domagala, 2018), which later metamorphosed into free-living filter feeders which occupy benthic zones (Zając & Zając, 2011).

Length-weight relationships are of wide range importance, such as estimating growth rates, age structure, and population dynamics (Tsoumani, *et al.* (2006); Moutsaki et al. (2014). Negative changes in growth rates may result in decreased individual health, reproductive success, and an increased risk of predation and mortality (Wootten, 1992). Variations in length-weight relationships are an indicator of fluctuations in the uptake and allocation of energy in aquatic organisms (Fafioye *et al.* 2018) and a function of environmental and anthropogenic factors. Damba Reservoir is a servicing and shallow reservoir (depth < 10m) with various anthropogenic uses. The fisherfolk often used cast nets to harvest fish, which disposed of and displaced bivalves from their niche. Coupled with other anthropogenic activities such as washing, irrigation, and municipal use, the effects of the fisherfolk could contribute adversely to the state of the wellbeing of the bivalves of the reservoir, which could pose a threat to morphological status and their existence. Hence, a study on the length-weight relationships of the bivalves to determine their present wellbeing is necessary. Information on the length-weight relationships is scarce and limited to specific areas (Vasconalos et al. 2018), and particularly in marine and brackish environments (Diouf *et al*. 2016; *Regalla et al.* 2013; Ansa and Allison, 2008). This study was therefore aimed at assessing the current state of wellbeing of A. anatina through their length-weight relationships.

MATERIALS AND METHODS

A total of 100 *Anodonta anatina* samples were collected from four sampling stations in Damba Reservoir (Fig. 2) according to the method of Brian and Aldridge (2020). Collection of bivalves from the substratum of each site was performed using improvised scoop nets and handpicking, and sorted by hand-picking, with hands protected with disposable hand gloves. The collected mollusks were sorted and taxonomically classified on the field, washed at collection sites, placed in labeled plastic containers containing water fetched from the reservoir, and transported to the laboratory for analysis. The length–weight relationship was determined by measuring various parts of the bivalve morphology using a digital Vernier caliper and weighing balance (to the nearest 0.1g). The length and weight parameters were subjected to a regression analysis. The power function W=aLb is used, where W is the dependent variable, L is the independent variable, a is the condition factor, and "b" is the regression coefficient (slope). The "a" and "b" values were obtained from a linear regression of the length and weight of the unionids measured.

The Fulton equation was used to determine the condition factor, following the equation: $a = W/L^3 \times 100$. Where L is the length and W is the weight. Data obtained were analysed using Excel statistical tool.

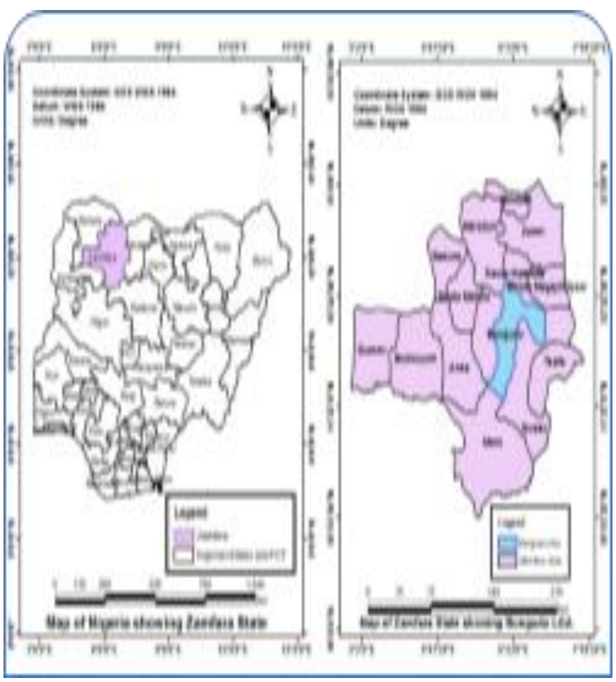

Fig.1 Map of Nigeria showing Zamfara State and Map of Zamfara State indicating Bungudu Local Government Area

Fig. 2. Satellite Map of Damba Reservoir

Plate 1: *Anodonta anatina*

RESULTS AND DISCUSSION

One hundred samples of *Anadonta anatina* were collected in Damba between months of March and June, 20023. The weight, standard length, lever or hinge length, umbo-anterior length, and height were measured. The length-weight (LW) relationships recorded in the present study revealed a negative growth pattern. Allometric growth occurs when the growth patterns are unequal. The negative allometric shown by shell dimensions against weight (Table 1) indicates a positive correlation between net weight and various morphological lengths. This implies that there is a proportionate increase in net weight and shell morphometrics, such as TL, H, LL, WD, and UAL.

This result corroborates the findings of Degamon and Gamalinda (2021) for *Anadontia edentula.* Allometric growth of shellfish provides a nondestructive and straightforward method for estimating biomass and total shell production (Ross and Lima, 1984). This could help predict the production rate of shellfish farming. Morphometric variables of TL out of all paired morphometric variables were the highest (1.2484 regression coefficient), with a coefficient of determination of 0.9278, which indicated that 92% of the total variation (net weight) accounted for the relationship with shell length.

The body morphometric relationship values obtained were liable to change over time, as Anadontidae could change their sex as well as being affected by the climatic and breeding seasons. Radhi *et al.* (2018) reported that body growth type changes sometimes according physiological needs of the body. This result was in contrast to the findings of Aban *et al.* (2017), who reported that shell width (WD) had more weight variation in Phychotriviridis. The slope values reported (Table 1) for TL-W, H-W, WD-W, LL-W, and UAL-W were < 3. Though, the result indicated negative allometry, which was against the LWR in bivalve findings of Petteta *et al.* (2019), Yahya *et al.* (2018), Ramesha and Sophia (2015), Perez and Santelli, (2018), who all reported b-values between 3.006-3.490. The difference might be the type of weight measured, as their results took into consideration net weight (NW); however, flesh dry weight was considered in their reports. This means that *A. anatina* from the Damba Reservoir grows in a negative allometric manner. This shows that the rate of increase in the net weight of *A. anatina* is inversely proportional to length morphometry. The b-value (regression coefficient) of the shell lengths of *A. anatina* in the Damba Reservoir (ranging from 0.8462-1.2484) against weight was in contrast to the findings of Wilbur and Owen (1964) and Radhi *et al.* (2018), who reported a b-value of 2.5 - 4.5.

The negative allometries from the report indicate that TL, WD, H, LL, and UAL grow faster than the increase in the weight of *A. anatina* (Plate 1) in the Damba reservoir. This agrees with the findings of Mendoza *et al.* (2019) and Gimin *et al.* (2004). The growth increase in length morphometry in A. anatina of the Damba reservoir might be due to morphological and physiological needs, such as strength to withstand the ecological stress of human impacts and weather. The allocation of energy for shell growth is higher than that for soft-body growth, which causes allometric growth. Gimin *et al.* (2004) stressed that factors such as reproductive state, density, physical and biological variables have effects on bivalve growth and it could change its allometry between the flesh and the shell.

Many factors, such as season and species also determine the LWR have also been reported to affect the LWR in organisms. Pollutant is a factor that could impact shell strength and weight as some chemical pollutant such as pesticides have been reported to cause depreciation. Gimin *et al.* (2004): Gaspar *et al.* (2002) reported that growth and shape of shell of bivalves are also determined by environmental factors like temperature, wave exposure, predation, and biological factors. Sediment nature is also an important factor in shell nature, as it can determine the bivalve depth and movement in water.

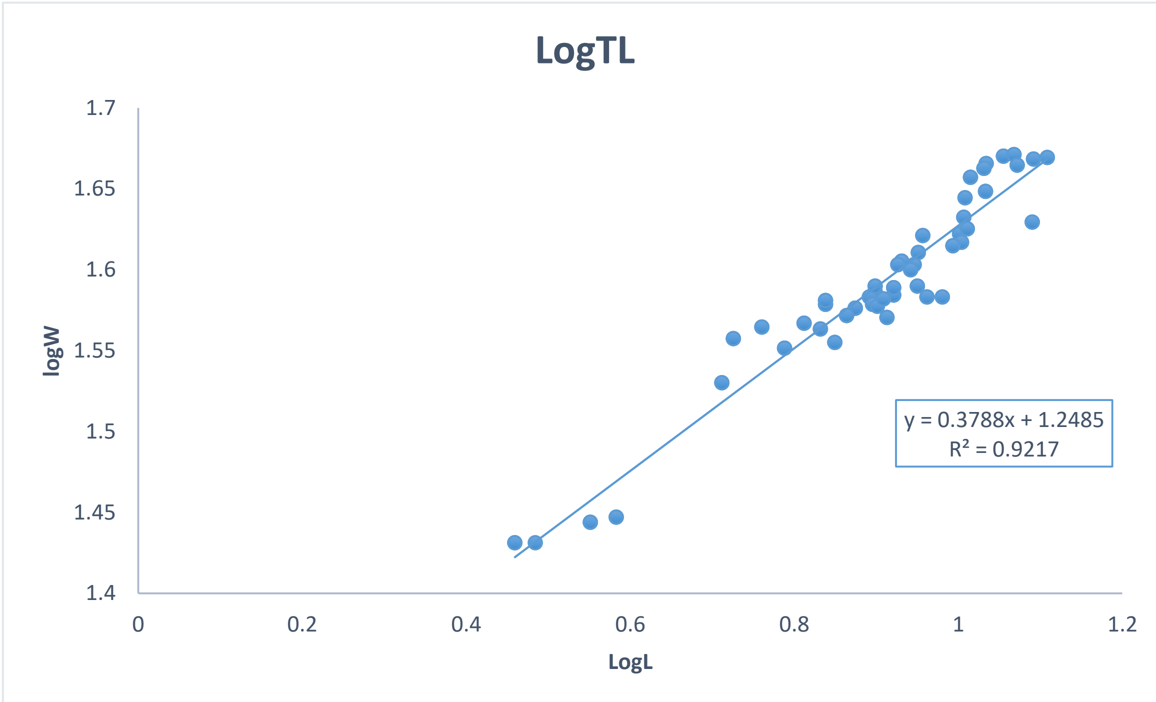

Fig 1: Total Length-Weight relationships

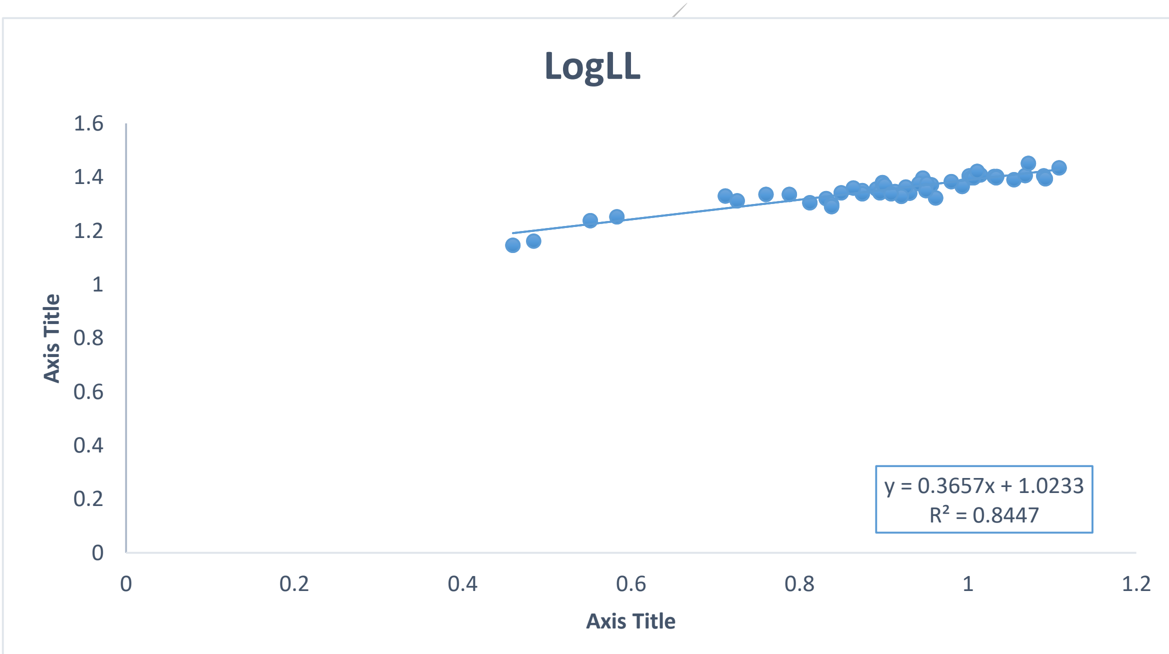

Fig. 2: Lever length – weight relationship

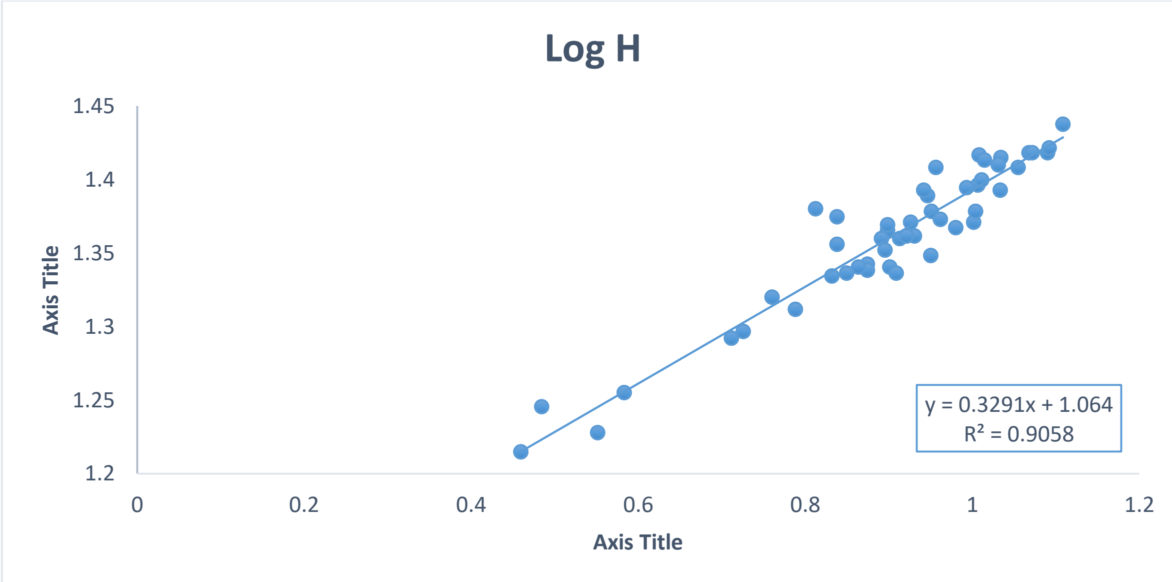

Fig. 3: Height – weight relationship

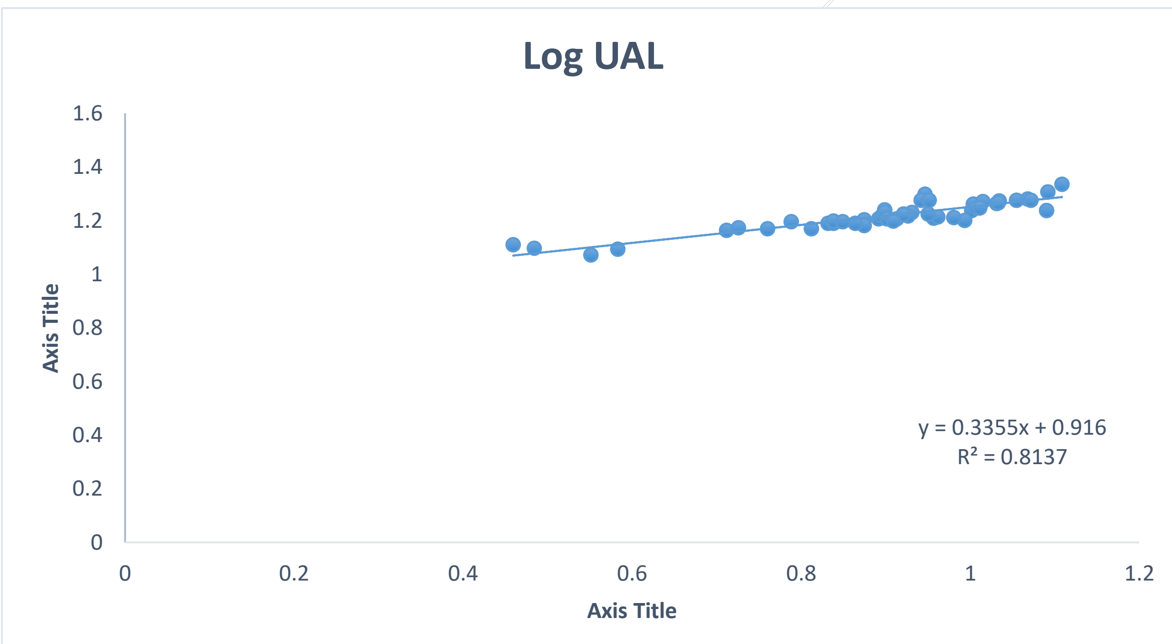

Fig. 4: Umbo-Anterior – Weight relationship

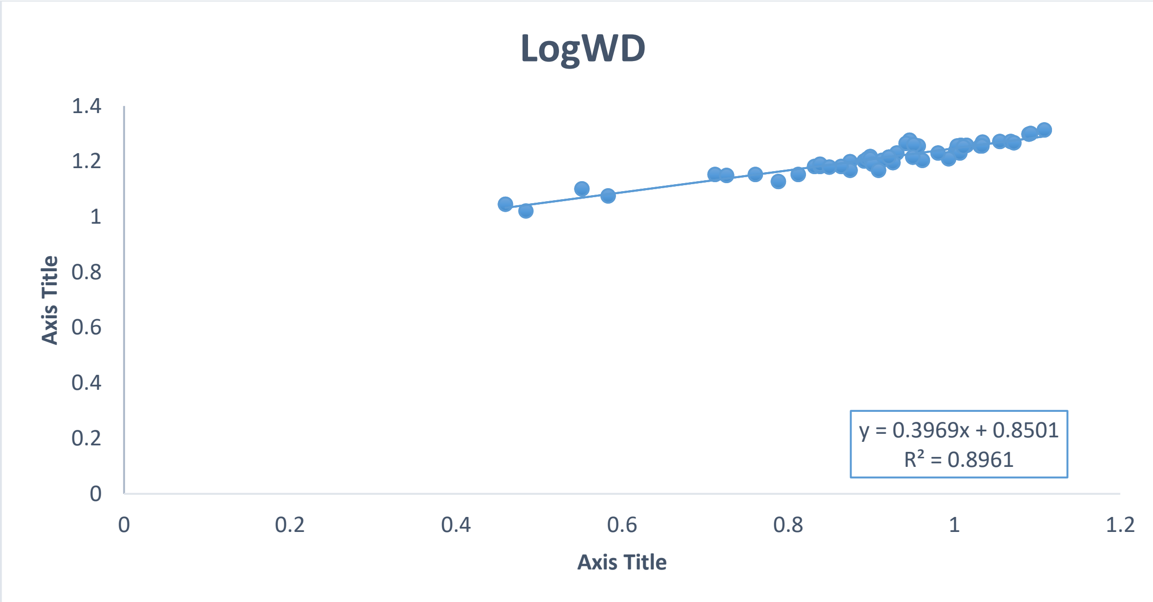

Fig. 5: Width-Weight relationship

Table 1: Summary of the relationships between net-weight and TL, H, WD, LL, and UAL pattern of *A. anatina.*

Variables	a	b	r	r^2	Growth (t-test)	Growth pattern
TL	0.3789	1.2484	0.9632	0.9278	b < 3	-ve Allometric
H	0.3247	1.0687	0.9534	0.9091	b < 3	-ve Allometric
WD	0.4011	0.8462	0.9512	0.9048	b < 3	-ve Allometric
LL	0.3733	1.0160	0.9259	0.8573	b < 3	-ve Allometric
UAL	0.3319	0.9195	0.9069	0.8225	b < 3	-ve Allometric

Key: TL (Total length), H (height), WD (width), LL (lever/hinge length), and UAL (Umbo anterior length)

CONCLUSION

The length-weight relationships (LWR) of *A. anatina* of Damba reservoir was studied. TL, H, WD, LL, and UAL were measured and compared against wet total weight. The LWR showed negative allometric growth with b values <3 (1.27, 1.07, 0.85, 1.02, 0.92 respectively). However, there is high correlation between TL-W (b = 1.25) relationship than relationships of weight to other morphological measurements. The study shows that shell lengths increases faster that the rate of increase in weight which indicate poor growth pattern of *A. anatina* during the study period.

Acknowledgement

The authors appreciate the efforts of the research assistants; Halimotu Saeed Usman, Nafiu Shafiu, and Nusaiba Maigari. The efforts of all researchers cited are well recognized; they all contributed to the success of the research.

Ethical Statements and Declarations

Funding

The research was a self-sponsored research and all expenses incurred were funded by the authors

Competing Interests

The authors declare that there is no conflict of interest in the research. If any objection arises after publication, the authors are ready to attend to it.

Ethical Approval: "N/A"

Authors Contributions

Conceptualization: Asiru Raheem Adekunle; Methodology: Adedeji Hameed Adebowale; Writing original draft, Samples and data collection: Asiru Raheem Adekunle; Data analysis Data analysis: Adedeji Hameed Adebowale. All authors read and consented to the final draft.

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