

## Comparative analysis of the individual age of blue shark in the Southwest Indian Ocean

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The blue shark, *Prionace glauca*, is a ubiquitous oceanic pelagic predator and one of the main bycatch species in longline fisheries worldwide. Amount of scientific and fisheries-related data is varies widely between regions. Little is known about this species from Southwest Indian Ocean, which makes difficult to evaluate and to quantify the status of this species. In this context, basic knowledge on life history traits such as growth rates and demographic structure of the populations are necessary for prediction of population responses to disturbances, such as fishing pressure.

Age and growth rate estimates for 48 individual blue sharks were obtained based on counting of growth increments on central cones of whole and sectioned vertebrae. Samples were collected in the southwestern Indian Ocean from dead individuals caught accidentally by commercial long-liners and during in research cruises from the East of Madagascar, along the Mozambique Channel and the West of Reunion Island. An anterior portion of the vertebral column (above the branchial chamber) was removed, thawed, cleaned of excess muscles and tissues, separated into individual vertebra and dried. The second or the third vertebra which was photographed whole before sectioning transversally into 0.7-0.9 mm thick slabs, using a Buehler low-speed saw with two diamond blades, was used for analysis. Growth bands in both cases were viewed using a binocular microscope with transmitted light. Each growth band consisted opaque zone on the section or as a ridge on the surface of the centrum for non-sectioned vertebra were considered as annuli.

Size of sampled sharks ranged from 125 to 243 cm fork length. Preliminary results indicated that the age estimates did not depend on the method of vertebral preparation. No statistical difference was found on age estimations between sectioned and whole vertebrae. Ages determined from whole vertebrae varied between 10 to 25 years, while age counts from the sections ranged from 10 to 23 years. The von Bertalanffy growth model using empirical length at birth provided the biological and statistical fit to the data. This model gave parameter estimates of  $L_{\infty} = 258$ cm fork length (FL) and  $k = 0.18 \text{ years}^{-1}$  for male and  $L_{\infty} = 252$ cm FL and  $k = 0.13 \text{ years}^{-1}$  for female. Male and female exhibited statistically significant differences in growth, indicating than female grow slower and are smaller than male. Our length-age estimates for blue shark are consistent with north Atlantic studies but highly differ from age estimated obtained from south Atlantic. Therefore an age validation study is required before hypothesis on annual growth band formation could be accepted.

**Keywords:** *Prionace glauca*, ageing, growth, vertebra, transverse section, growth bands, von Bertalanffy

# COMPARATIVE ANALYSIS OF THE INDIVIDUAL AGE OF THE BLUE SHARK, *PRIONACE GLAUCA* IN THE SOUTH-WEST INDIAN OCEAN

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# CONTEXT

## ✚ Shark

- Total capture: 800 000t/yr
- Indian ocean: 241 000t (30%)

## ✚ BSH

- Pelagic
- Cosmopolitan distribution
- Annual capture : 10 - 20 millions of individuals
- Major bycatch of the longliner

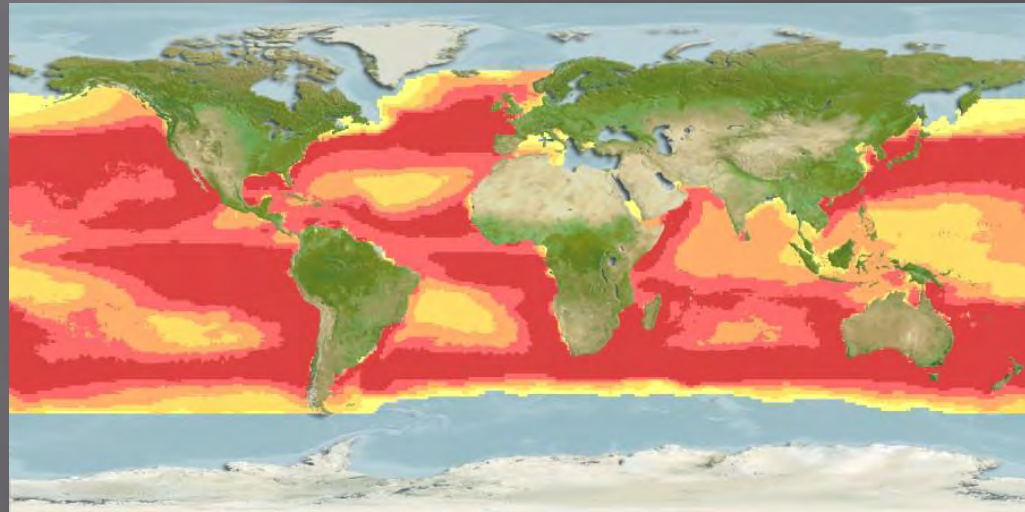
## ✚ BSH

- r-side of the life-history spectrum
- Shark capture misinformed
- Limited number of observer program
  - ✚ Distort stock evaluation
  - ✚ Lack of biological data and reliable statistics



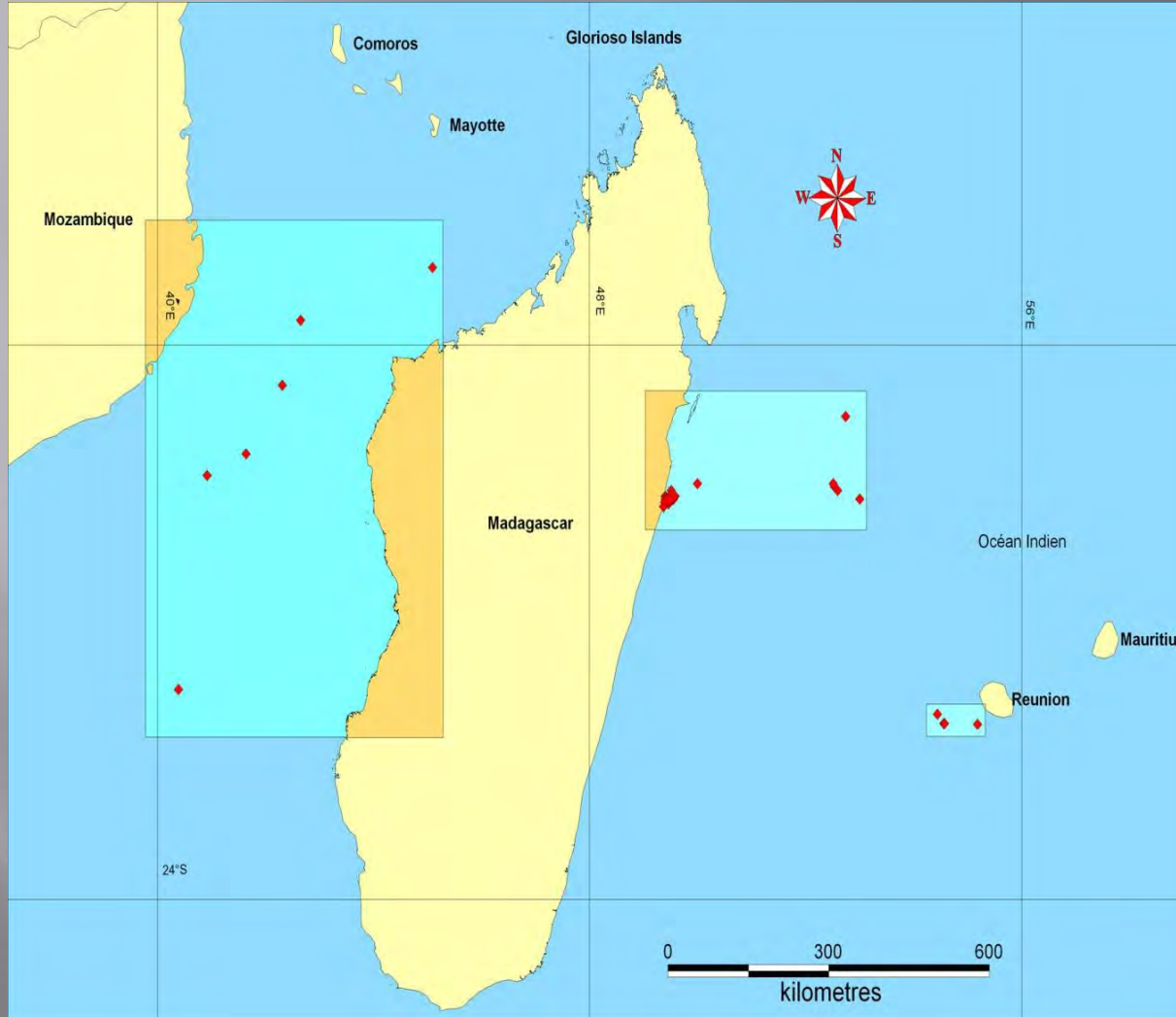
# OBJECTIVES

- ✚ Age, individual growth rate, longevity
- ✚ Useful for stock assessment and fishery model
- ✚ To characterise the BSH population
- ✚ ?? Biogeography
- ✚ ?? Growth rate difference between male-female



# MATERIALS AND METHODS

# SAMPLING BY REGIONS



- Légendes**
- Pays
  - Océans
  - ◆ Echantillonnages (Point GPS)
  - ▲ Ports
  - Capitales
  - Villes

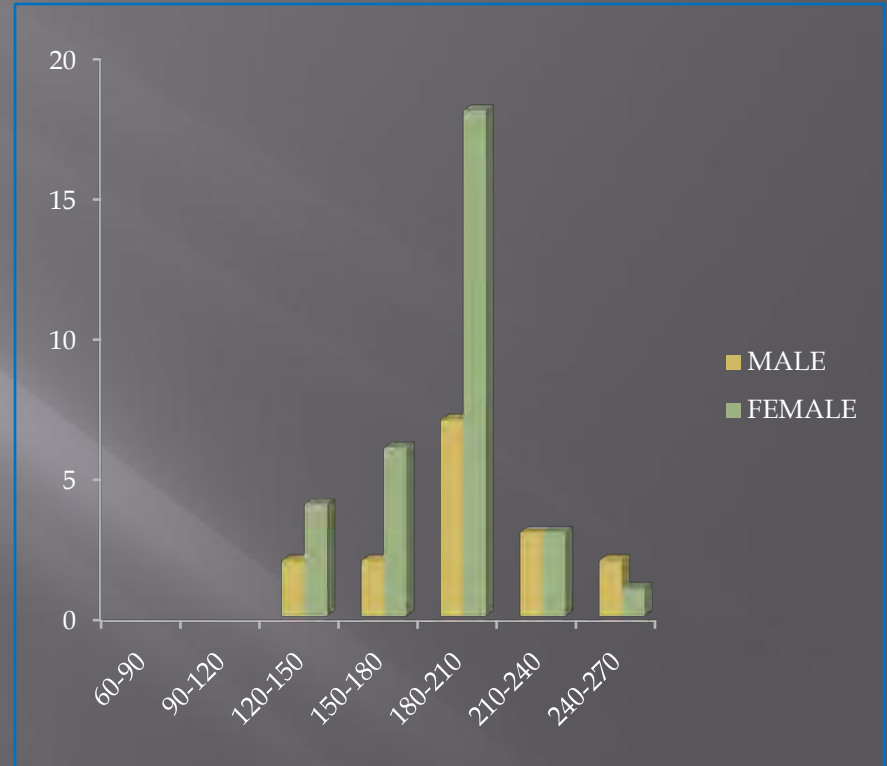


# SAMPLE COLLECTION

Regions	Reunion			Madagascar		
Size class	S	M	B	S	M	B
Vertebra	0	10	3	0	24	11

S (Small): FL < 120cm,  
M (Medium): 120cm < FL < 200cm,  
B (Big): FL > 200cm

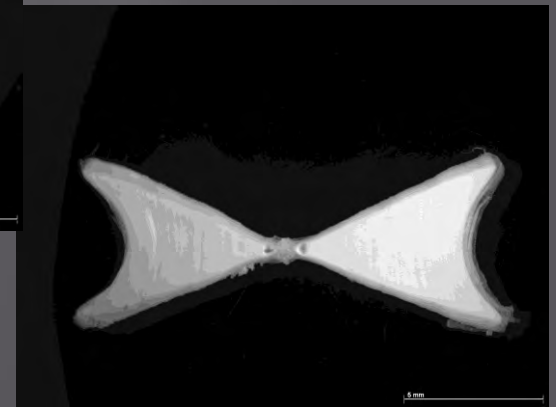
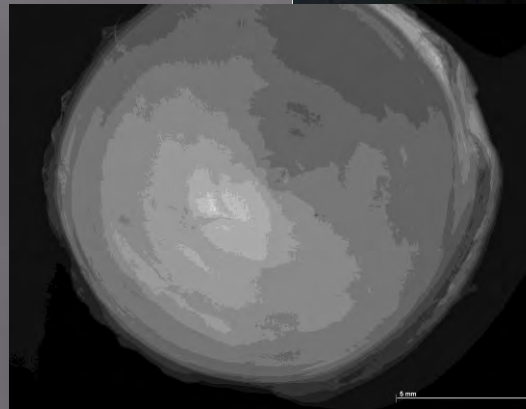
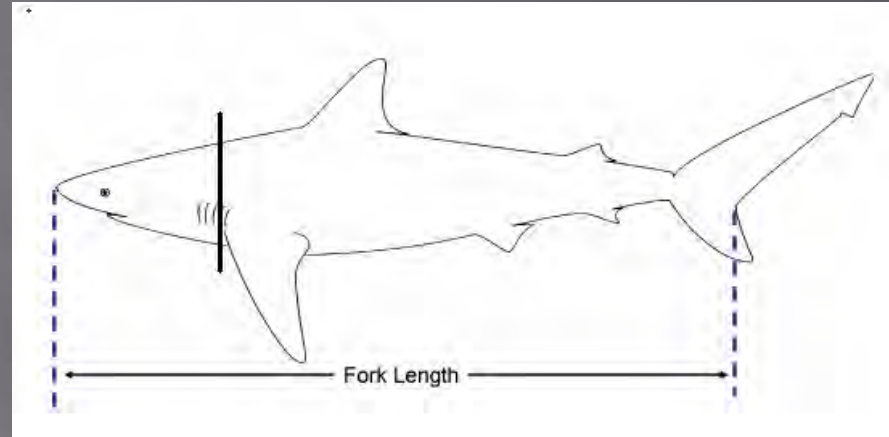
FL	MALE	FEMALE
Mean	192	184
SSQ	38	29



Size-frequency distribution of sharks examined during the present study. , Male (n=16); female (n=32)

# SAMPLE PREPARATION

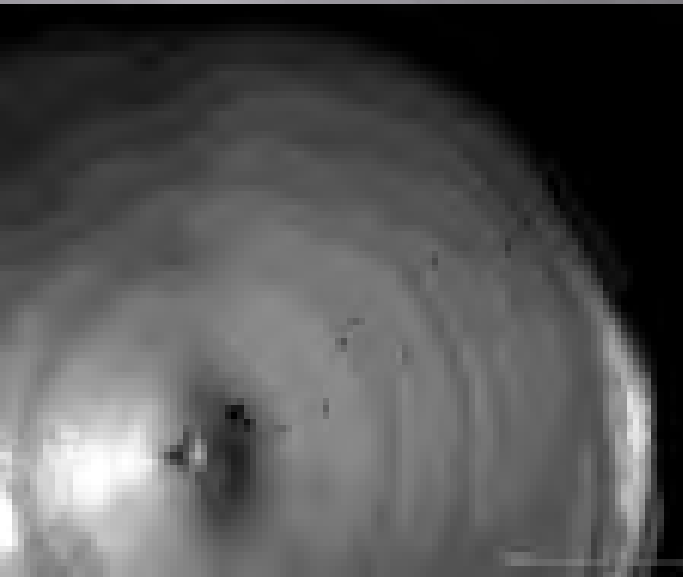
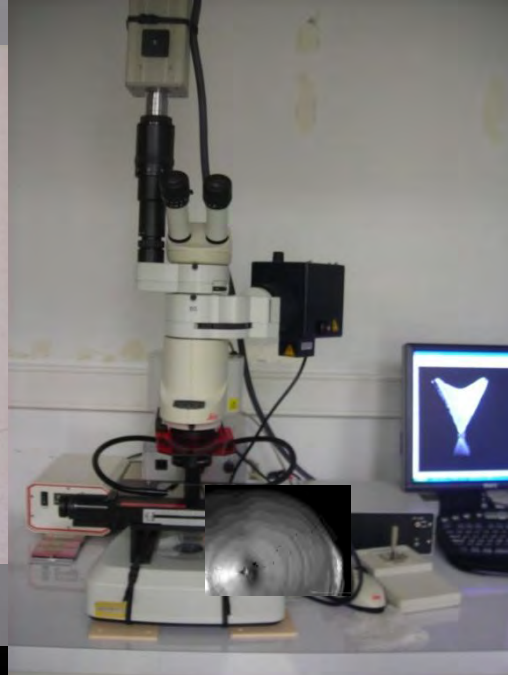
- ✚ Section of 5-10 cm of vertebral column, above the branchial chamber
  - Cleaned of excess tissue and dried
- ✚ Complementary data: (FL, sex, state, pups, etc.)
- ✚ Second vertebrae removed for ageing



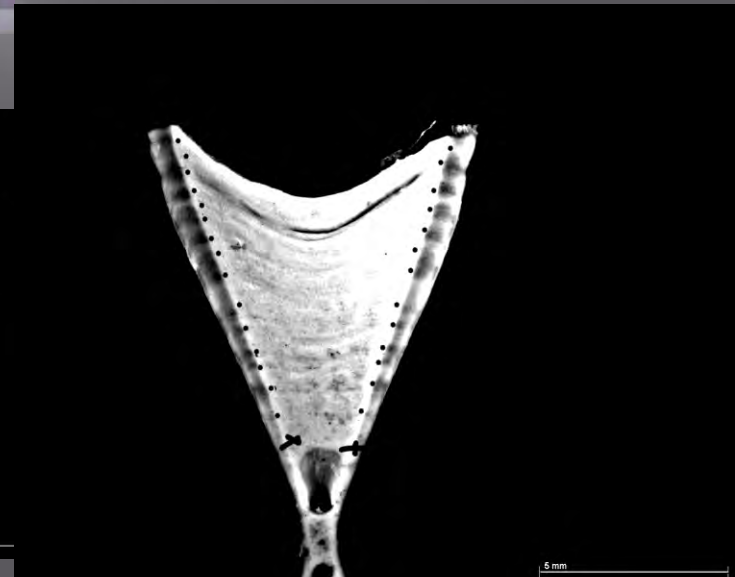
# WHOLE VERTEBRA



## Microscopy with TNPC



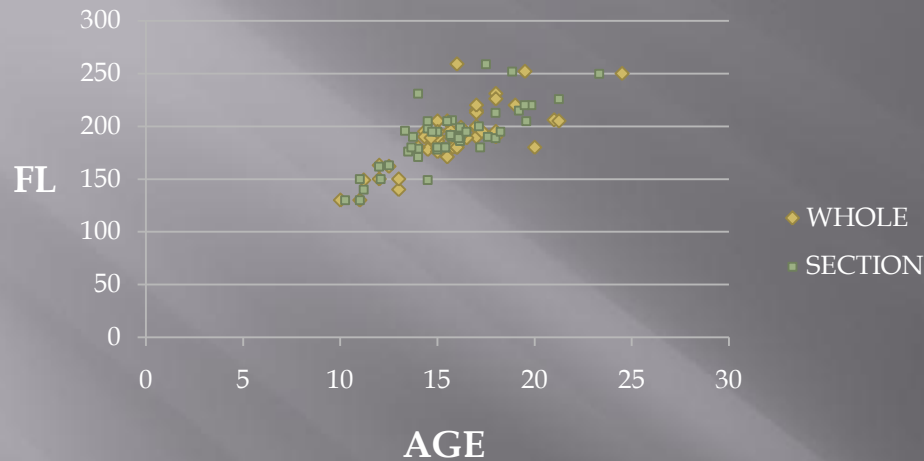
# SECTIONNED VERTEBRA



# RESULTS

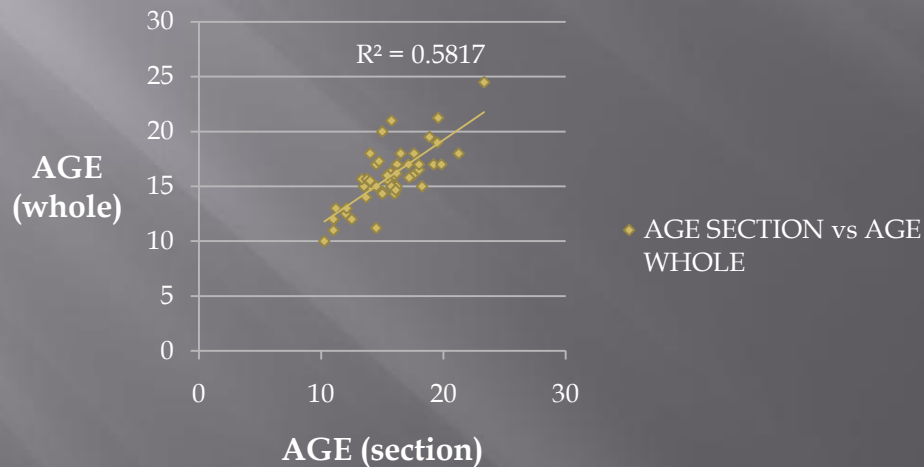
# AGE COMPARISON BETWEEN WHOLE AND SECTIONNED VERTEBRA

## AGE (whole and section) vs FL

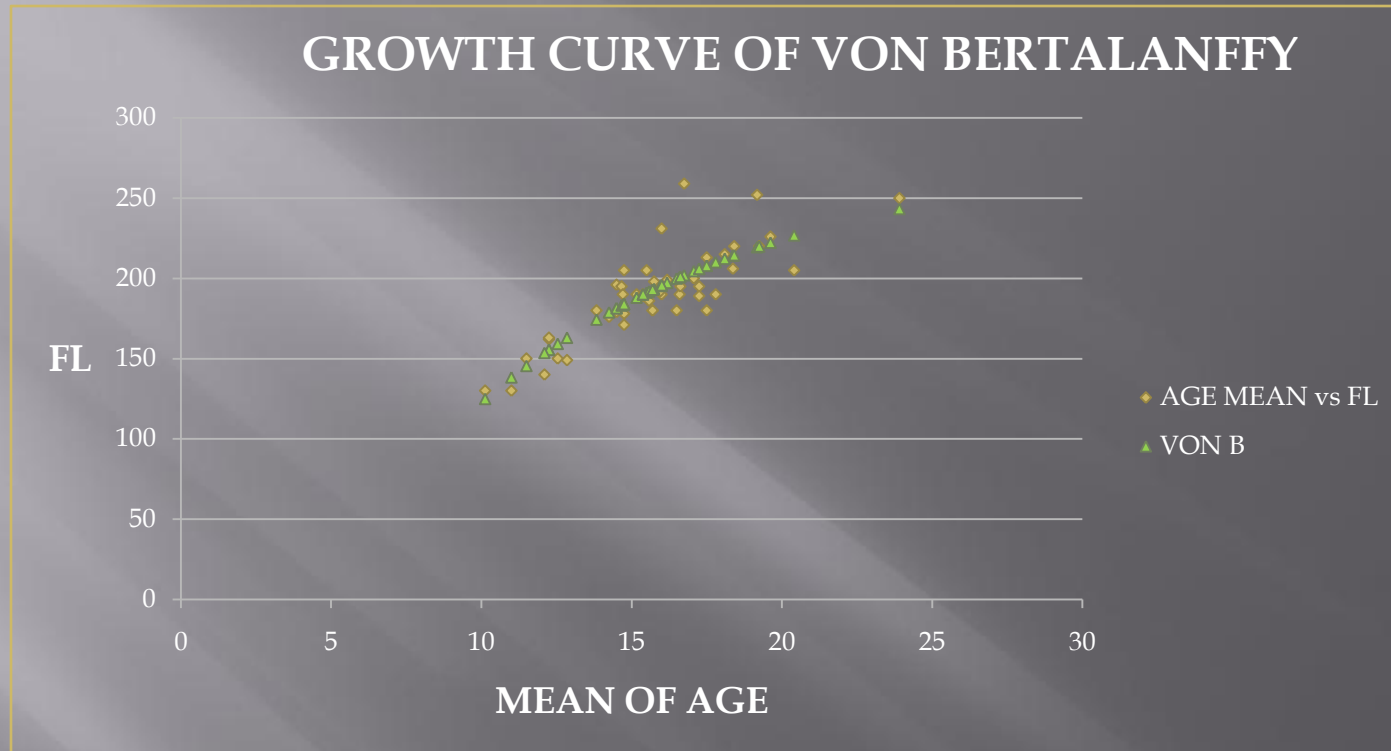


- Mean (age whole) = 17.65
- Mean (age section) = 17.39
- Difference = 0.26
- t = 0.97
- p value = 0.33

## AGE SECTION vs AGE WHOLE



# GROWTH CURVE OF THE BLUE SHARKS



$L_{\infty}$	k	$t_0$
281	0.103	4

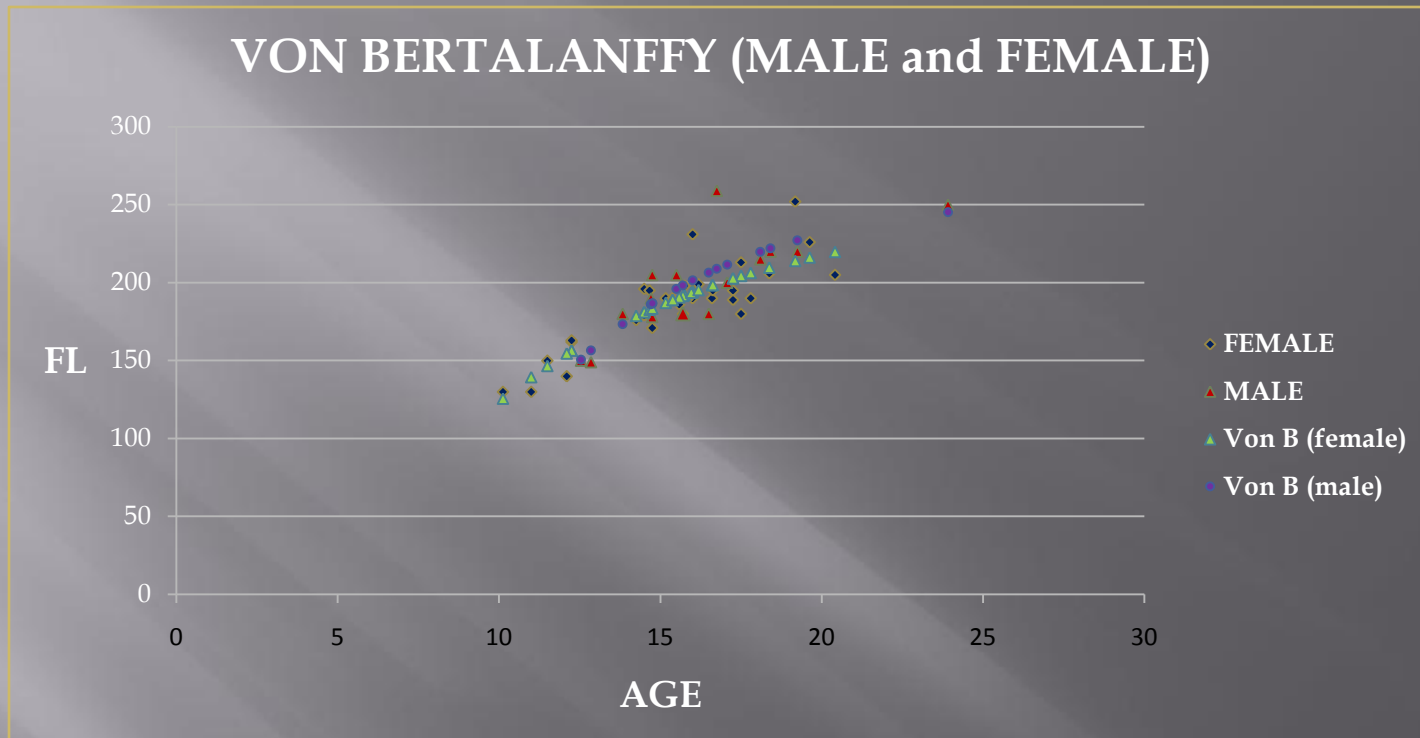
Relationship between age and FL:

$$(1) y = 8,978x + 48,96 \quad (R^2=0.679)$$

Von Bertalanffy growth curve equation:

$$(2) Lt = 281 * (1 - \exp(-0.103 * (t - 4)))$$

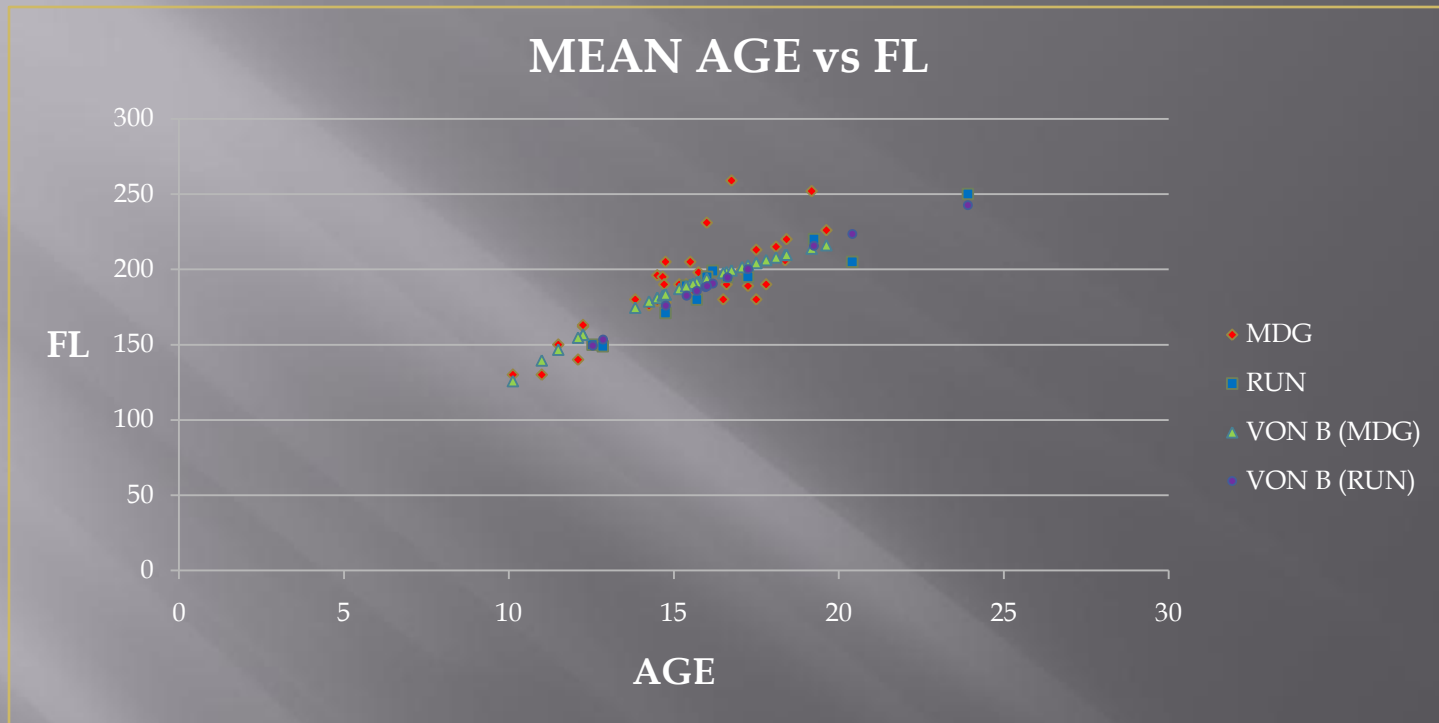
# COMPARISON OF THE GROWTH CURVE BETWEEN SEX



	$L_{\infty}$	K	$t_0$
Male	258	0.184	7.80
Female	252	0.130	4.87

■ Mean (age female) = 18  
 ■ Mean (age male) = 21  
 ■ p value = 0.618

# COMPARISON OF THE GROWTH CURVE OF THE BLUE SHARK BETWEEN REGIONS



	$L_{\infty}$	K	$t_0$
MDG	252	0.13	4.87
RUN	291	0.09	4.88

■ Mean (age MDG) = 17  
■ Mean (age RUN) = 22  
■ p value = 0,500

# DISCUSSIONS AND CONCLUSIONS

- ✚ No significant difference between whole and sectioned vertebra
- ✚ Overestimation of all ages due to :
  - Diminution of the number and space between annuli at the edge of the corpus calcareum (Natanson & al., 1990)
  - Presence of true and wrong annuli (Campana, 2001)
  - Definition of the birth mark (Campana, 2001)
- ✚ With whole vertebra: ageing possibility above 8 years
  - To enhance visibility of the annuli
    - ☀ Enough transmitted light
    - ☀ Whole cleaned enough and section wet enough
- ✚ Von B  $t_0$  and  $L_\infty$  not similar to the value obtained in the North-east Atlantic (Henderson, 2000)
  - $t_0$  South-west Indian Ocean >  $t_0$  North-East Atlantic
  - $L_\infty$  South-west Indian Ocean >  $L_\infty$  North-East Atlantic
- ✚ Existence of sexual dimorphism (15years – FL=170cm) **BUT** to review the age because of overestimation
- ✚ Capture: mainly female and large size like into the result of Stevens (1976) and Henderson (2000)
  - May be an indication of size segregation or a result of fishing pressure
- ✚ A little bit difference of length-age relationship between RUN and MDG
  - May be a difference of prey nature, chemical and physical conditions
- ✚ Need small size and more sample
- ✚ Recurrent problem → verification and validation of the age

**THANK YOU!!!**

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