

# **Examination of Baculum Measurements in the Male South African Fur Seal**

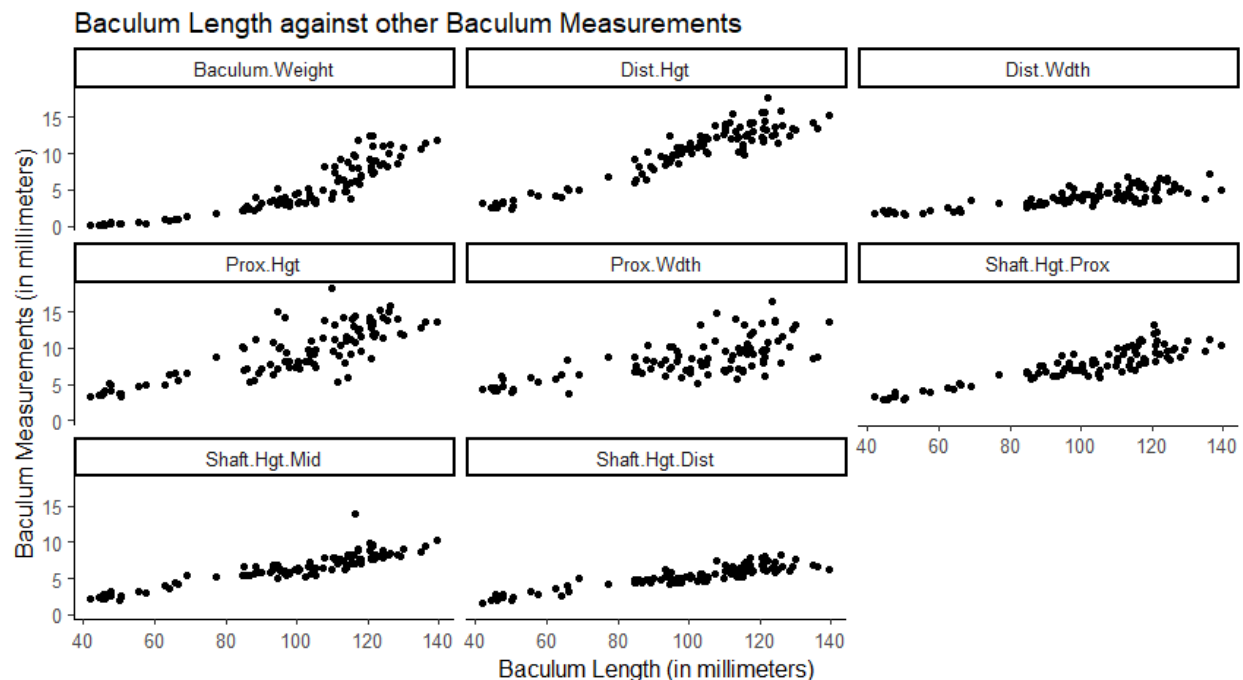
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## INTRODUCTION

In this study, the length of the baculum bone found in the male South African fur seals is analysed to determine whether it is a useful indicator of the standard body length of seals. In addition, the various measurements of the baculum parts are examined to find any correlation with the baculum length. A data set of 100 male South African fur seals comprising of yearlings (7 months to 1 year 6 months), subadults (1 year 7 months to 7 years 6 months) and adults (greater than 7 years 7 months) is considered for this study. All the measurements are provided in millimeters except the standard body length which is in centimeters.

## ANALYSIS

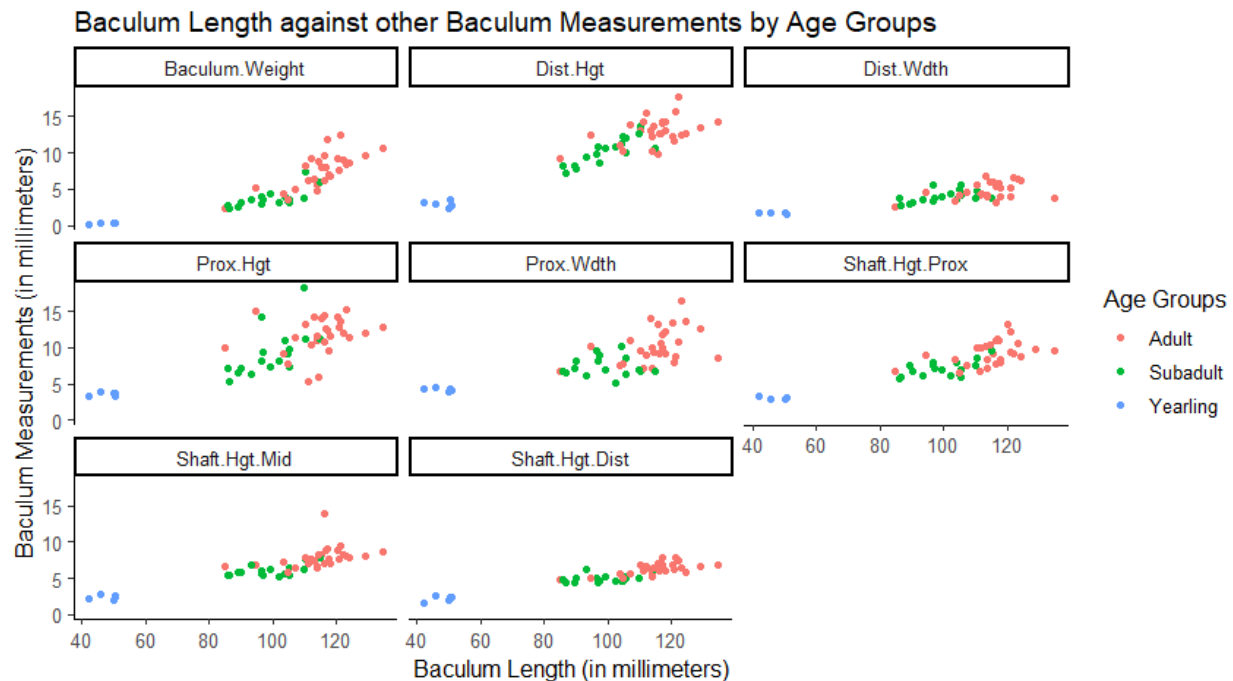
### Relationship between Baculum Length and other Baculum Measurements



The scatterplots of Baculum Weight, Distal Height, Distal Width, Proximal Shaft Height and Distal Shaft Height against Baculum Length shows strong, positive and linear association between the variables. While the scatterplot of Mid Shaft Height against Baculum Length also shows strong, positive and linear association between the variables, it does show a clear outlier.

However, the scatterplots of Proximal Height and Proximal Width against Baculum Length shows only a moderately strong, positive and linear association between the variables.

## Relationship between Baculum Length and other Baculum Measurements by Age Groups



It is difficult to determine any relationship between the variables for Yearlings as only a very small sample size of 5 seals is available. If a relationship still needs to be established, the scatterplots of all baculum measurements against the Baculum Length, in general, does seem to have strong, positive and linear association between the variables.

Under Subadults, the scatterplots of Baculum Weight, Distal Height, Distal Width, Proximal Shaft Height, Mid Shaft Height, Distal Shaft Height against Baculum Length show strong, positive and linear association between the variables. While the scatterplot of Proximal Height against Baculum Length also shows strong, positive and linear association between the variables, it does show two clear outliers. However, the scatterplot of Proximal Width against Baculum Length shows only a moderately strong, positive and linear association between the variables.

Under Adults, the scatterplots of Distal Width, Proximal Shaft Height and Distal Shaft Height against Baculum Length show strong, positive and linear association between the variables. The scatterplot of Mid Shaft Height against Baculum Length also shows strong, positive and linear association between the variables, but it also shows one clear outlier. However, the scatterplots of Baculum Weight, Distal Height, Proximal Width against Baculum Length show only a moderately strong, positive and linear association between the variables. The scatterplot of Proximal Height against Baculum Length also shows moderately strong, positive and linear association between the variables, but it also shows four clear outliers.

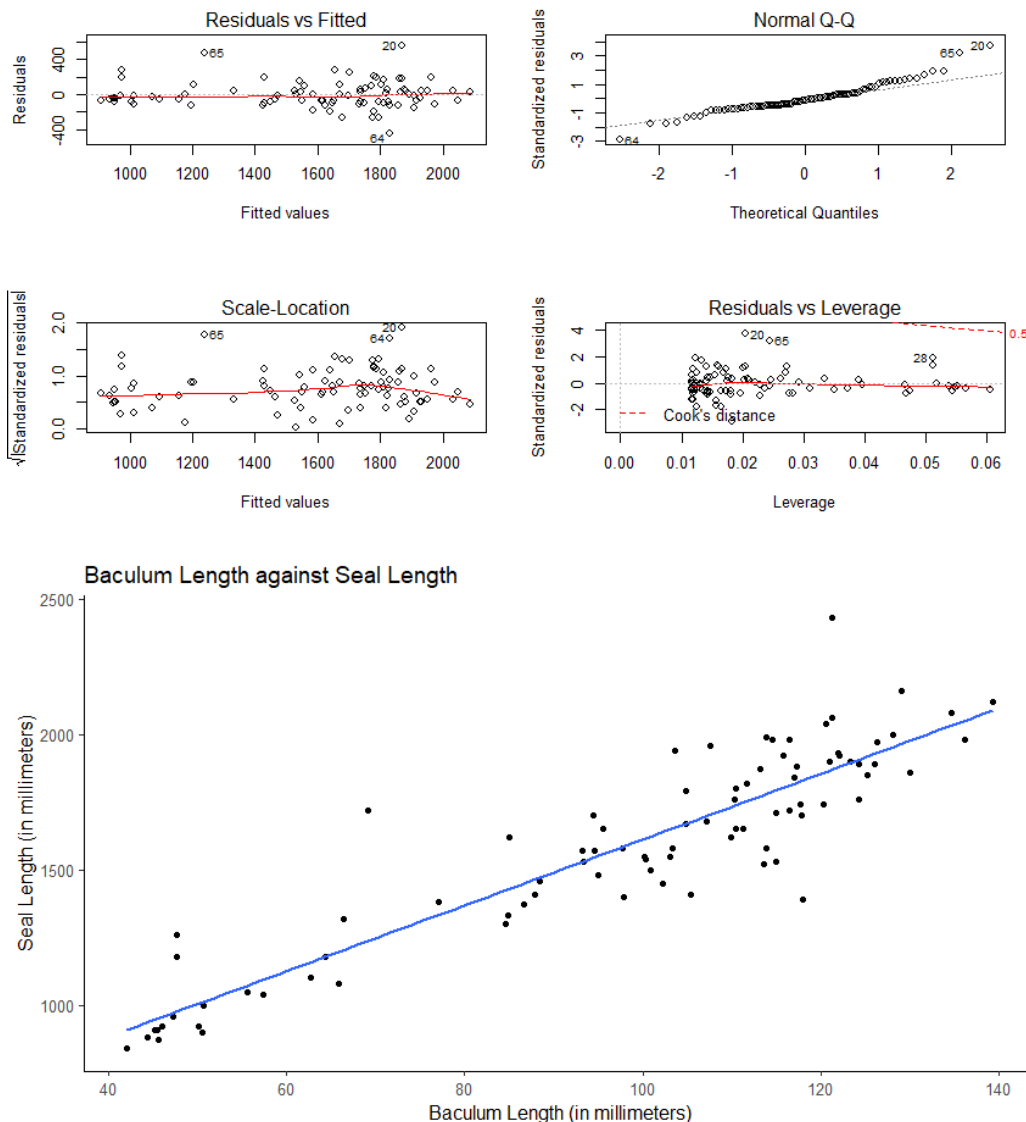
## Relationship between Baculum Length and the Standard Body Length of Seal

In order to determine whether Baculum Length is a useful indicator of the Standard Body Length, a linear model is fit between the two variables and checked for assumptions.

The 'Residuals vs Fitted' plot tests the assumptions of whether the relationship between the two variables is linear. The residuals are symmetrically distributed along the zero line with few potential outliers indicating linearity.

The 'Normal Q-Q' plot helps us determine if our dependent variable is normally distributed by plotting quantiles from our distribution against a theoretical distribution. The standardized residuals are mostly along the regression line indicating normality.

The assumptions have been satisfied and the model is found to be adequate.



A scatterplot drawn between Baculum Length and Seal Length suggests a linearly increasing relationship between the variables suggesting that the relationship between response and predictor variables is linear and additive.

The correlation value between Baculum Length and Seal Length is 0.9088789 which is closer to 1 suggesting a strong positive linear relationship. The R-squared value is also greater than 0.70 with the standard error closer to zero.

The summary of the linear model is as follows.

Call:

```
lm(formula = Seal.Lgth ~ Baculum.Length, data = datav4)
```

Residuals:

Min	1Q	Median	3Q	Max
-440.08	-86.13	-17.74	56.96	561.05

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	396.6367	61.6411	6.435	7.25e-09	***
Baculum.Length	12.1478	0.6082	19.973	< 2e-16	***

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 152.8 on 84 degrees of freedom  
(14 observations deleted due to missingness)

Multiple R-squared: 0.8261, Adjusted R-squared: 0.824

F-statistic: 398.9 on 1 and 84 DF, p-value: < 2.2e-16

The fitted equation is Standard Body Length = 396.6367 + (12.1478 \* Baculum Length)

## CONCLUSION

There seems to be relationships between Baculum Length and other baculum measurements but none of the measurements can be clearly attributed for the length of the baculum bone. However, the Baculum Length does seem to be a useful indicator of the Standard Body Length of seals.