

Age and growth patterns of the bull (*Carcharhinus Leucas*) and pigeye (*C. amboinensis*) sharks in northern waters



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Accurate age estimates are prerequisites to realistic survival patterns

- Estimate the longevity of the species
 - maximum age
 - age at maturity
 - growth rate
 - differences in growth between males and females.
- Identify key age cohorts
- Monitor changes in age structure and species resilience overtime



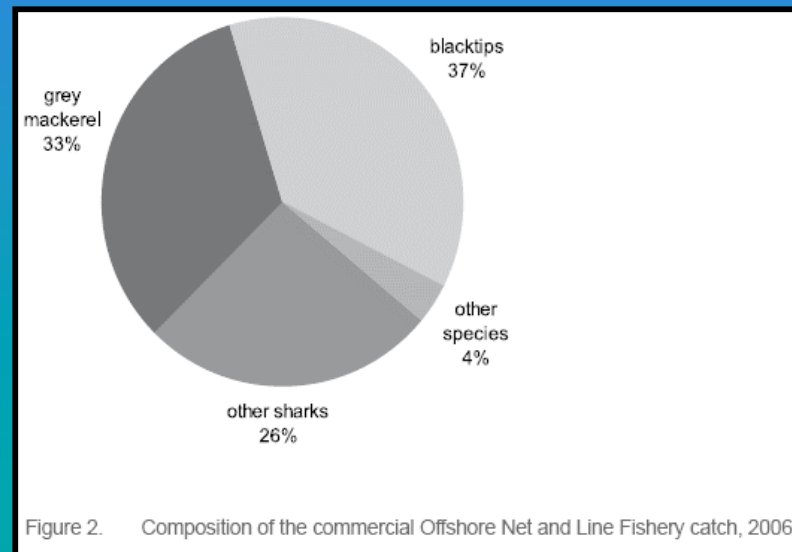
Sharks globally threatened

- Typically K-selected life history traits
- Require adequate measures for predicting their resilience to changes in the environment



Shark third highest catch value wild harvest fishery in the Northern Territory in 2006

- 780 tonnes reported shark catch in NT in 2006
- 26 % of total catch consists of non-target sharks, mostly carcharhinids
- Little is known about age structure of Carcharhinids in northern waters

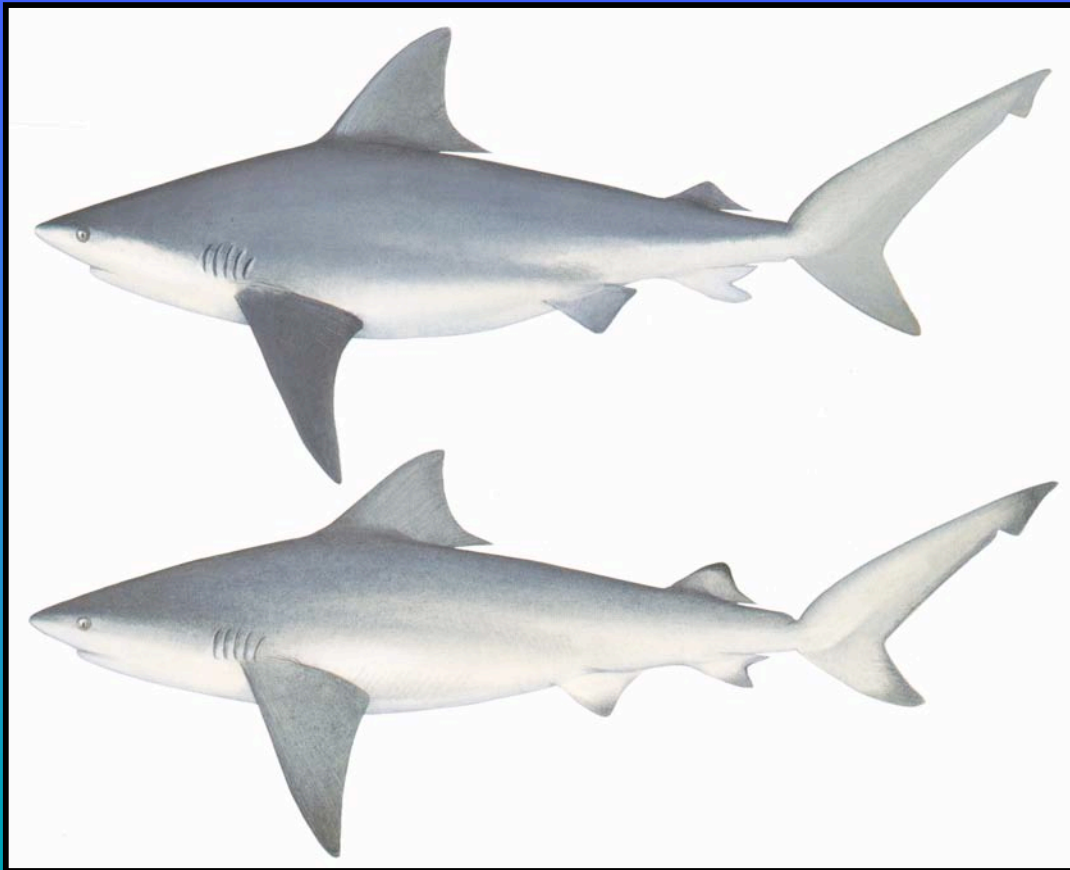


Bull and pigeye sharks

- Common apex predators in shallow tropical environments
- Bull shark IUCN classification “globally threatened”
 - Age and growth estimates have been recorded for South Africa and northern and southern regions of the Gulf of Mexico.
- Pigeye shark IUCN classification “data deficient”



Spot the differences



Pigeye shark
C. amboinensis

Bull shark
C. leucas

Morphologically similar, Ecologically similar ?

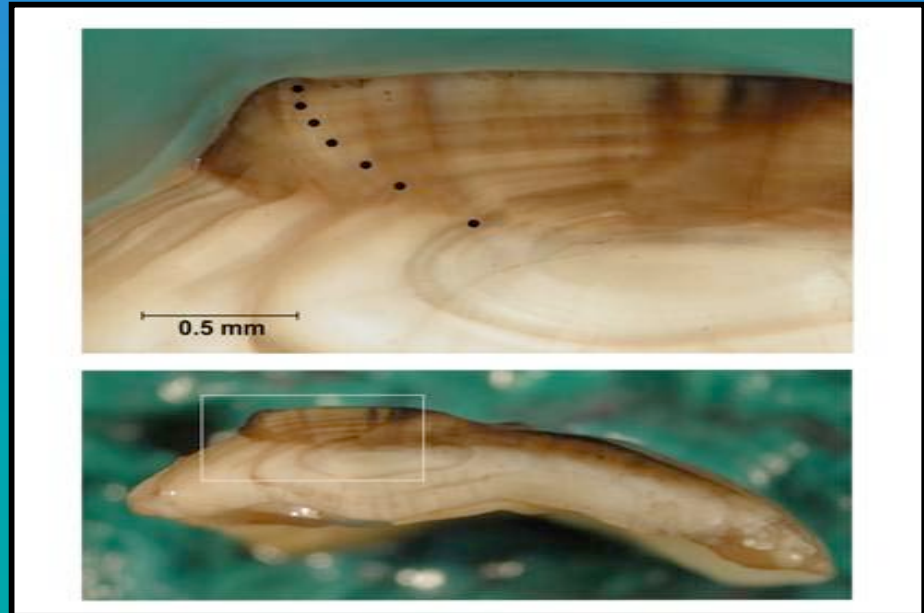
Aims

- To estimate age and growth parameters of bull and pigeye sharks by directly counting the growth increments in thoracic vertebrae
- To compare age and growth parameters of the bull and pigeye sharks to identify if there are any differences in their life history traits



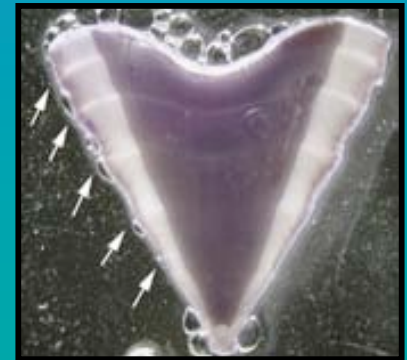
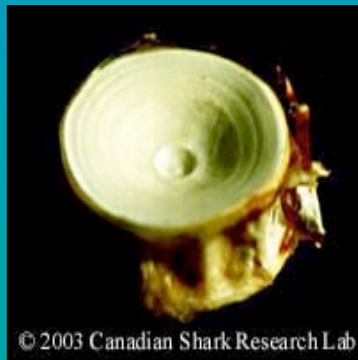
Methods

- Based current aging methods in teleosts
 - Scales
 - Otoliths
 - Bones
- Elasmobranchs lack heavily calcified structures
 - Vertebrae
 - Dorsal spines
 - Caudal thorns
 - Neural arches



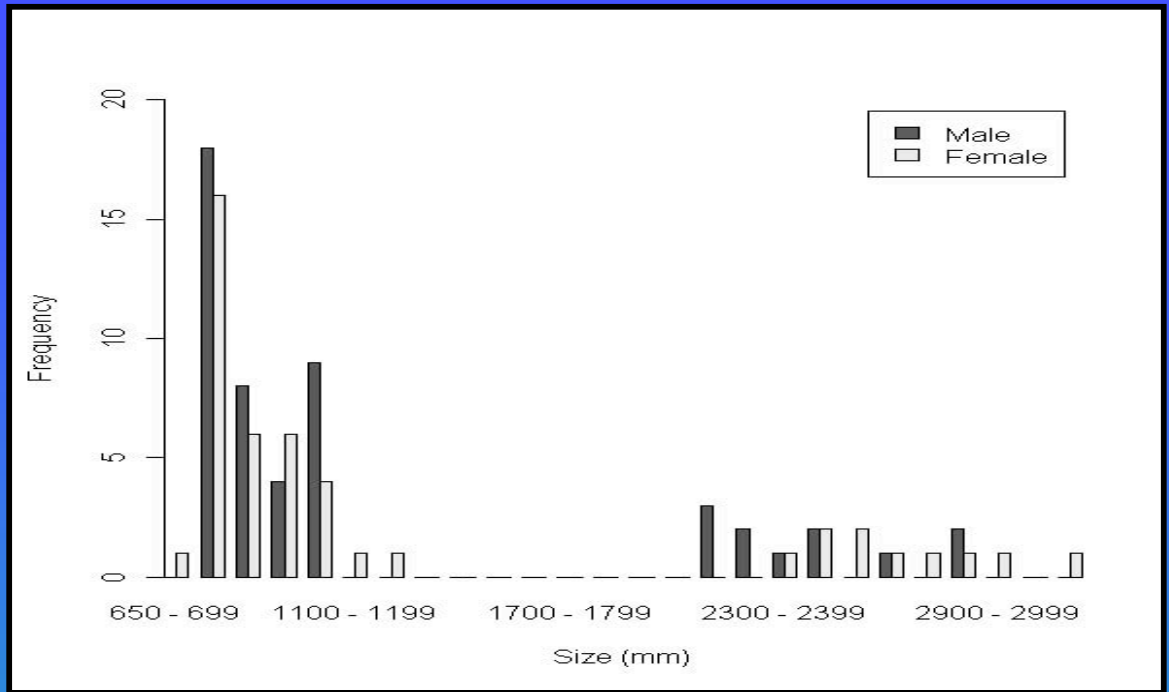
Methods

- Remove the largest vertebrae below the dorsal fin
- Clean and section vertebra
- Count growth bands

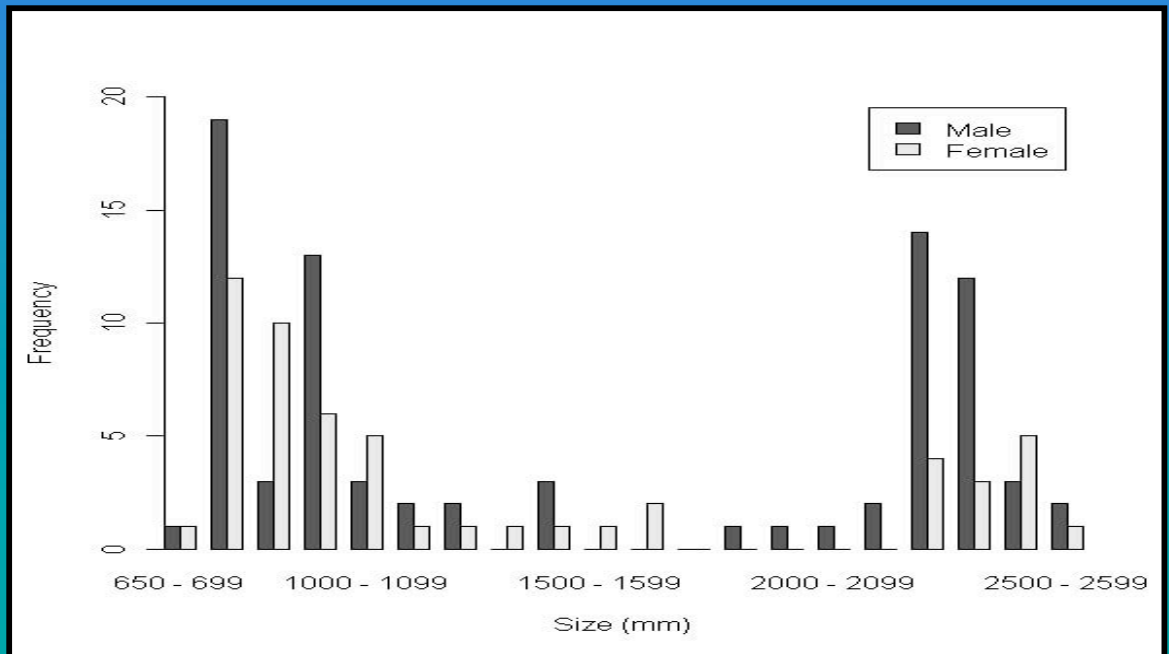


Results

Bull shark
n = 91



Pigeye shark
n = 144



Growth Models

- Von Bertalanffy Growth Model
most widely used
- Not necessarily the best fit
- Modelled three functions
 - Von Bertalanffy Growth Model (VBGM)
 - 2 parameter VBGM (2VBGM)
 - Gompertz Growth Model



Combined sexes

- The model that best fit the data was determined by nonlinear least squares and Akaike's Information Criterion

- Gompertz growth model best describes data

- Pigeye shark

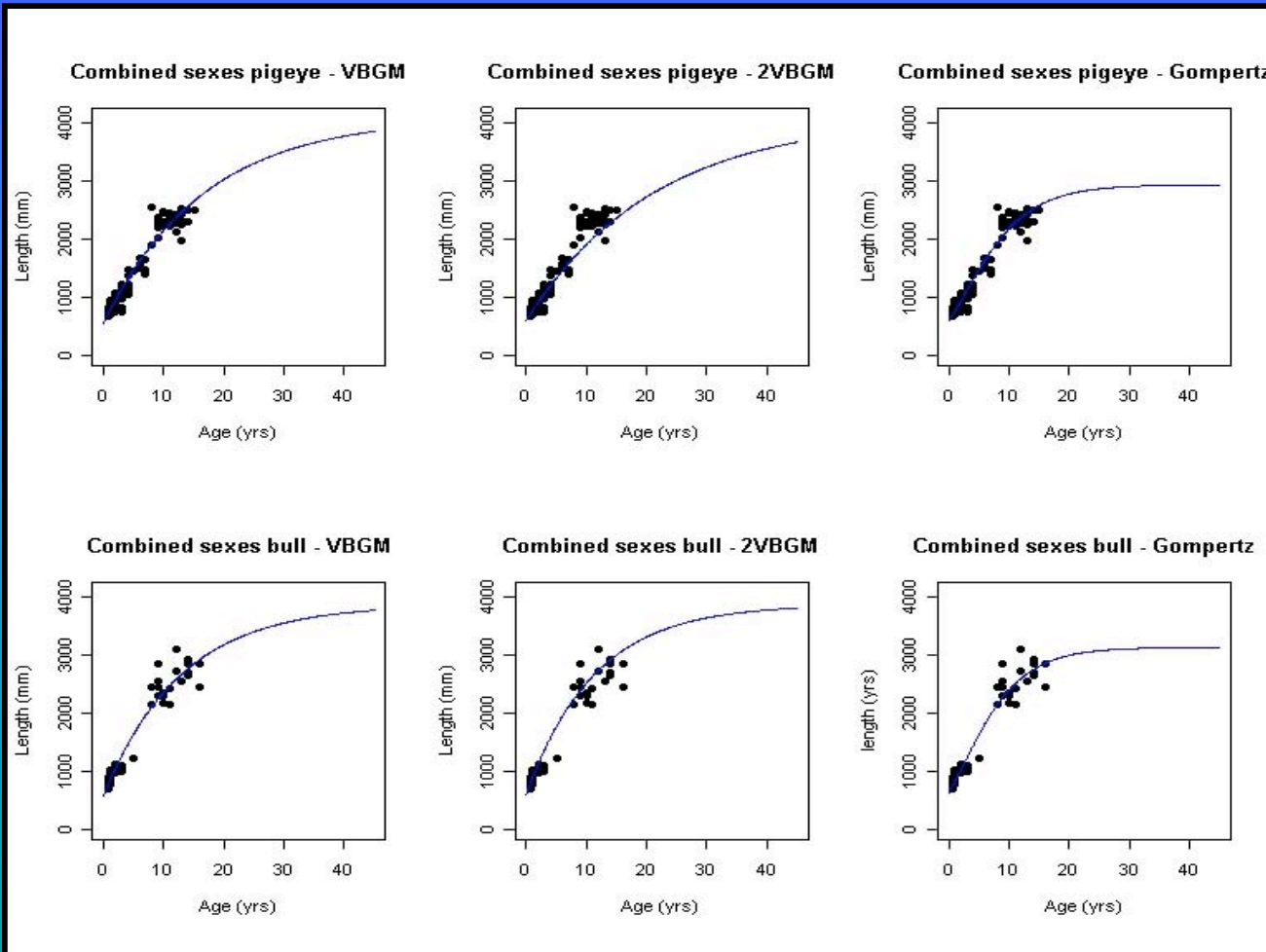
$$L_{\infty} = 2927$$

$$k = 0.16$$

- Bull shark

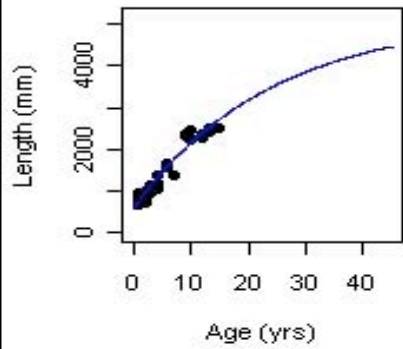
$$L_{\infty} = 3122$$

$$k = 0.17$$

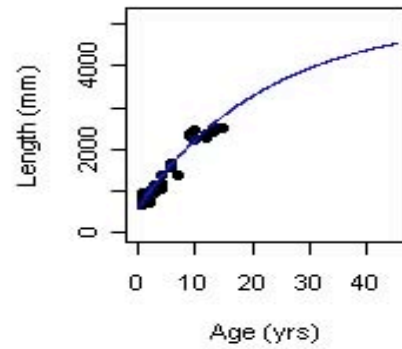


Females

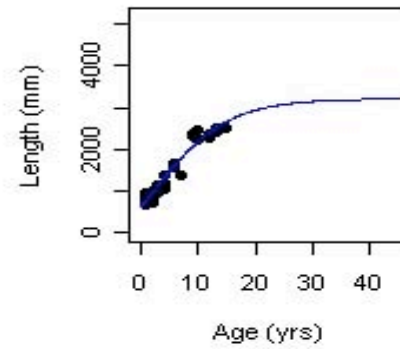
Female pigeye - VBGM



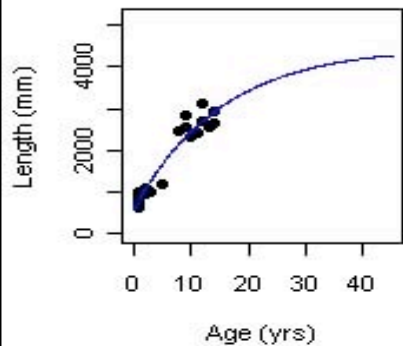
Female pigeye - 2VBGM



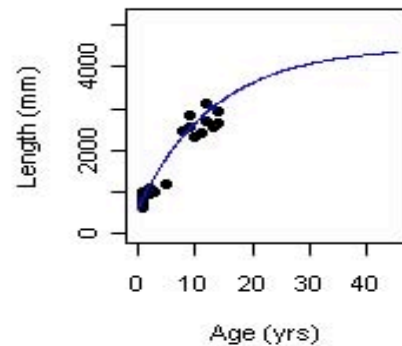
Female pigeye - Gompertz



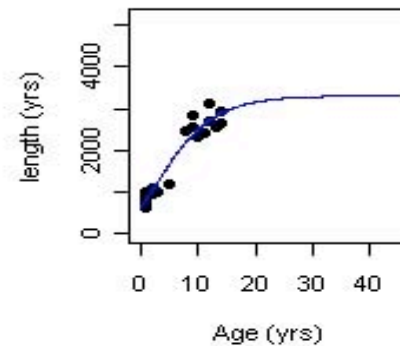
Female bull - VBGM



Female bull - 2VBGM



Female bull - Gompertz



- Gompertz model best fit

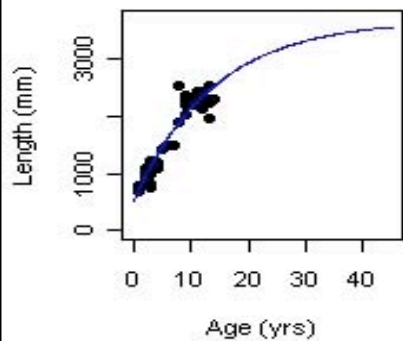
- $L_{\infty} = 3211$
 $k = 0.14$

- $L_{\infty} = 3304$
 $k = 0.179$

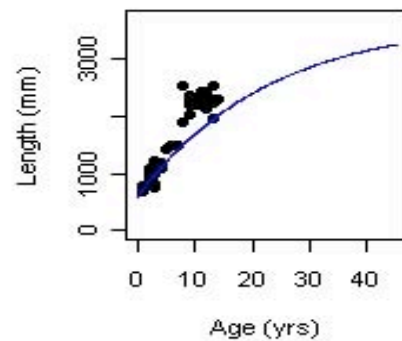
Males

- Gompertz model best fit

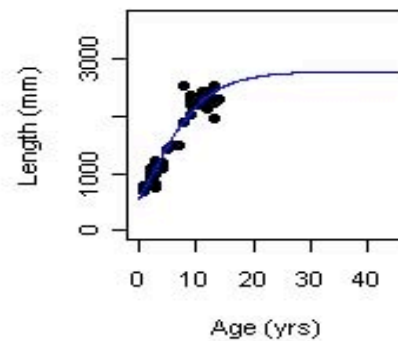
Male pigeye - VBGM



Male pigeye - 2VBGM

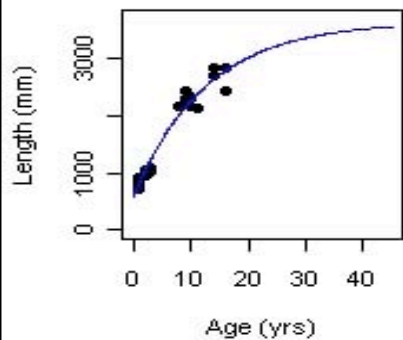


Male pigeye - Gompertz

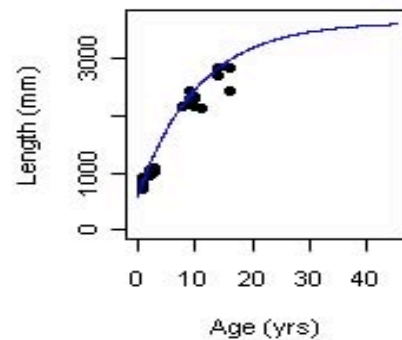


- $L_{\infty} = 2785$
 $k = 0.18$

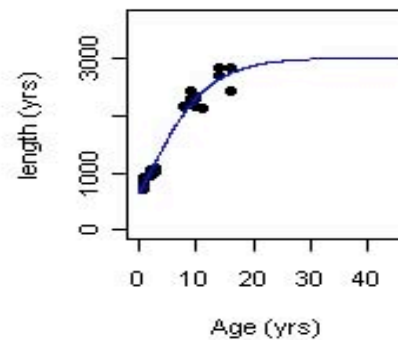
Male bull - VBGM



Male bull - 2VBGM



Male bull - Gompertz



- $L_{\infty} = 3016$
 $k = 0.17$

Conclusions

Bull shark

- Larger estimates of maximum size
- Faster growth rate
- Similar in conclusion that females obtain larger sizes than males



Study	Models compared	Best model	L_{∞} (mm)	k (years ⁻¹)	t_0 (years)	n
Neer <i>et. al</i> (2005)	VBGM, 2VBGM	2VBGM	2289.2 (80.7)	0.089 (0.007)	NA	254
Branstetter & Stiles (1987)	VBGM	VBGM	2850	0.076	-3	59
Cruz-Martinez <i>et. al</i> (2004)	VBGM	VBGM	2564 (64.9)	0.139 (0.02)	-1.935 (0.56)	95
Cliff & Dudley (2002)	a selection of 10 models	VBGM	2300 (110)	0.071 (0.011)	- 5.12 (1.09)	123
Current Study	Gompertz, VBGM, 2VBGM	Gomperts	3122 (143.6)	0.179 (0.01)	NA	94

Conclusion

Pigeye shark



- First estimates of age and growth parameters
- Estimates slightly larger than maximum recorded catch size
- Similar growth rate as bull sharks, smaller max size
- Von Bertalanffy growth parameters (combined sexes)
 - $L_{\infty} = 2927$ mm, $k = 0.16$

How susceptible are the bull and pigeye sharks to overexploitation?

- Both sharks long lived
- k estimates suggest similar growth rates
- Relatively slow growing though not as slow as some



First step in population viability assessments (PVA)

- Data needs to be combined with
 - reproductive potential
 - mortality estimates
- Facilitate identification of key cohorts



Thank you

