SCRS/P/2025/010

Relationship between vertebral band pairs deposition and age in shortfin mako sharks

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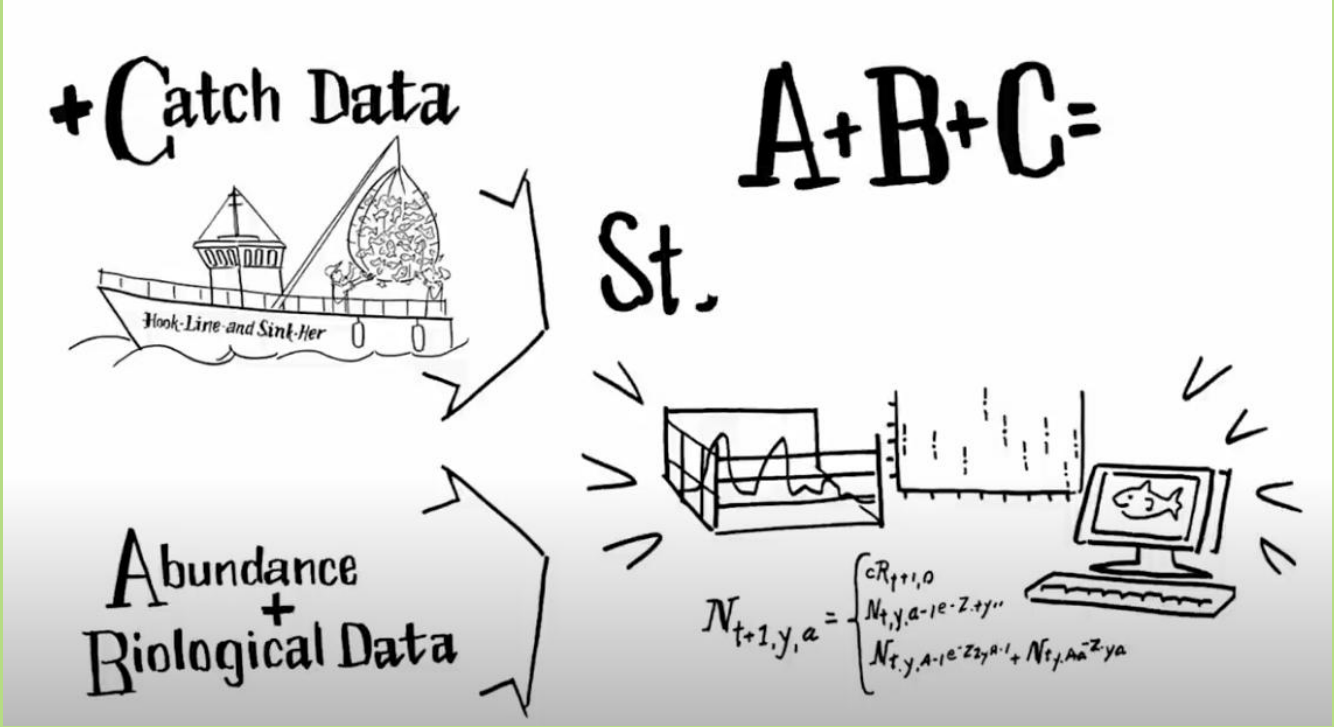
Fisheries science manuals indicate three main key-elements

A B C

for the assessment of exploited fish stocks assessment (Mejuto *et al.* 2021).



NOAA https://www.youtube.com/watch?v=3UbWMdpavUE

Fisheries science manuals indicate three main key-elements – **ABC** – for the assessment of exploited fish stocks assessment (Mejuto *et al.* 2021).

A: those related to the estimation of the Abundance over the years / indicators of relative abundance

B: the variables that define the Biology of the species-stock

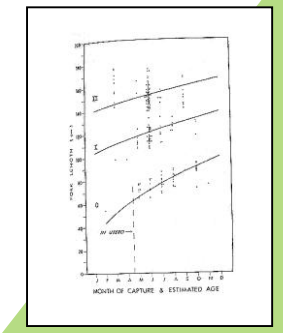
C: the Catches taken by the fleets.

The selected growth curve has a great impact on the biomass over time as well as on the estimation of other biological parameters (age at maturity, natural mortality, productivity, etc.) used as input in some assessment models.

Age and growth rate of shortfin mako, *Isurus oxyrinchus*, could be determined using **differents methods**:

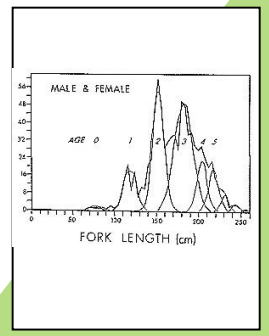
Age and growth rate of shortfin mako,

methods

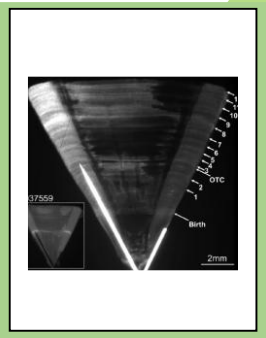


- Temporal analysis of length-month information

- Results of tagging data



- Length-frequency analysis



-Ring counts on hard parts: vertebrae
The **interpretation of vertebral bands**

most popular method shortfin mako growth

What is the relationship between the pairs of bands and the age of the shortfin mako?

Cailliet *et al.*
1BP

44 vertebra SMA (90-321 TL) (95% - ranged in size from 90 to 220 cm TL).

1983

Pratt & Casey
2BP

Analyzing length-frequency, length-month and tagging data **a biannual deposition is concluded**. The vertebrae from four recaptured SMA gave inconclusive results. Two supported the hypothesis that an annual ring is formed. The other two indicated that two rings were formed each year.

Campana *et al.*
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Analyze the atomic bomb footprint in the vertebrae of 15 porbeagles and infer the same behavior in the sample of **1 female 328 cm FL SMA**.

2002

2006

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Samples of vertebra from 2 males (183, 232 TL) & 6 females (133, 240, 309, 350, 355, 366 TL) collected during 1963-84 period. Application of bomb radiocarbon chronologies to SMA age validation.
The results support the **annual band-pair** interpretation for SMA aged up to 31 years, but **does not rule out the early age findings for biannual band-pair deposition**.

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The **tag/recapture curves and the length–frequency modes indicate a much faster growth for the young mako sharks** than the vertebral growth indicates. (Up to 193 cm CFL at recapture and up to 215 cm CFL length-frecuency).

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29 OTC- injected juvenile (79 - 142 cm FL at release; 98 – 200 cm FL at recapture; 0.25-4.4 years at liberty) + 14,720 length-frecuency (85% - ranged in size from 80 to 160 cm FL)
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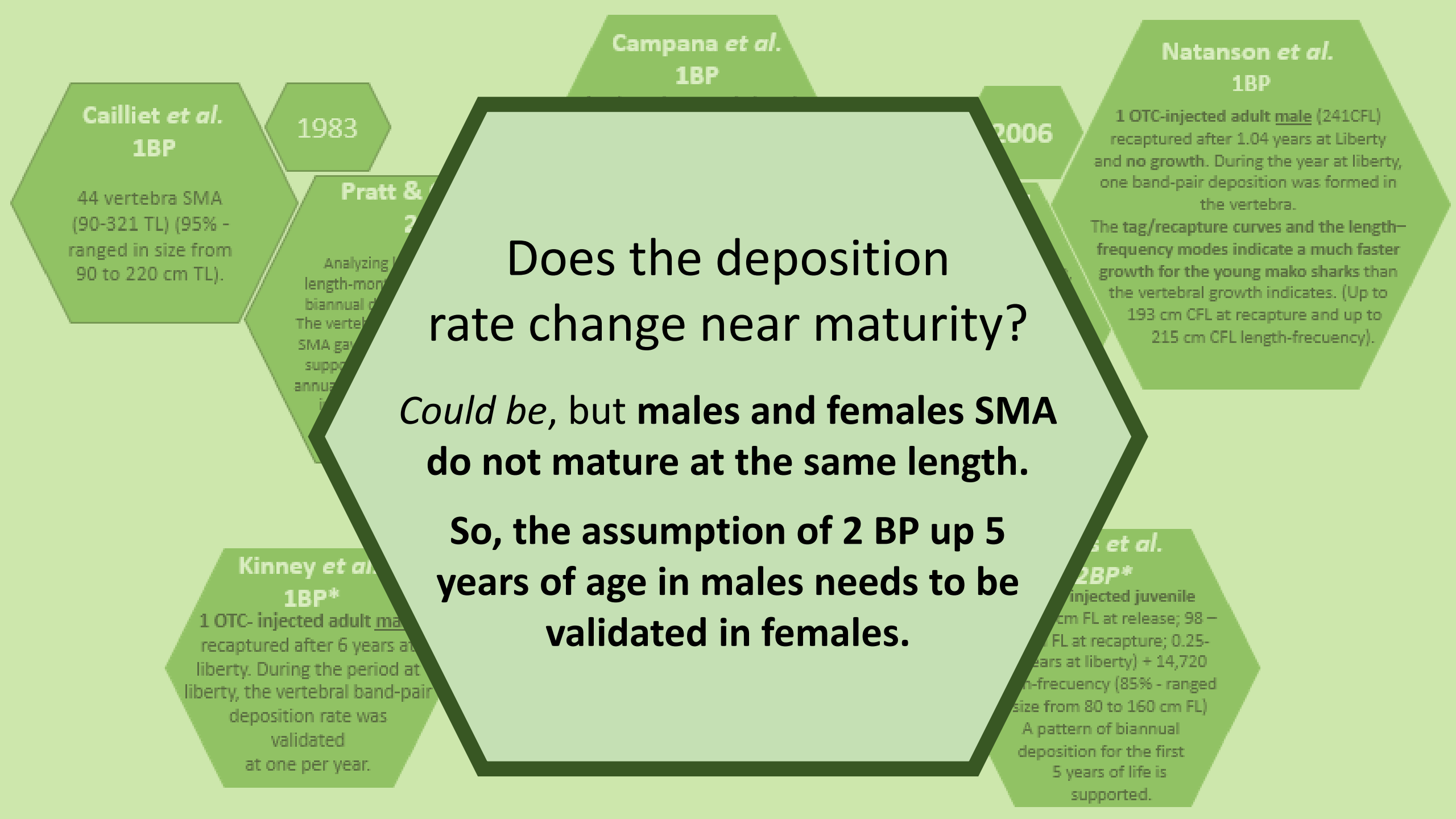
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So, the assumption of 2 BP up 5 years of age in males needs to be validated in females.

Natanson *et al.* 2018

Age and growth of sharks: do vertebral band pairs record age?

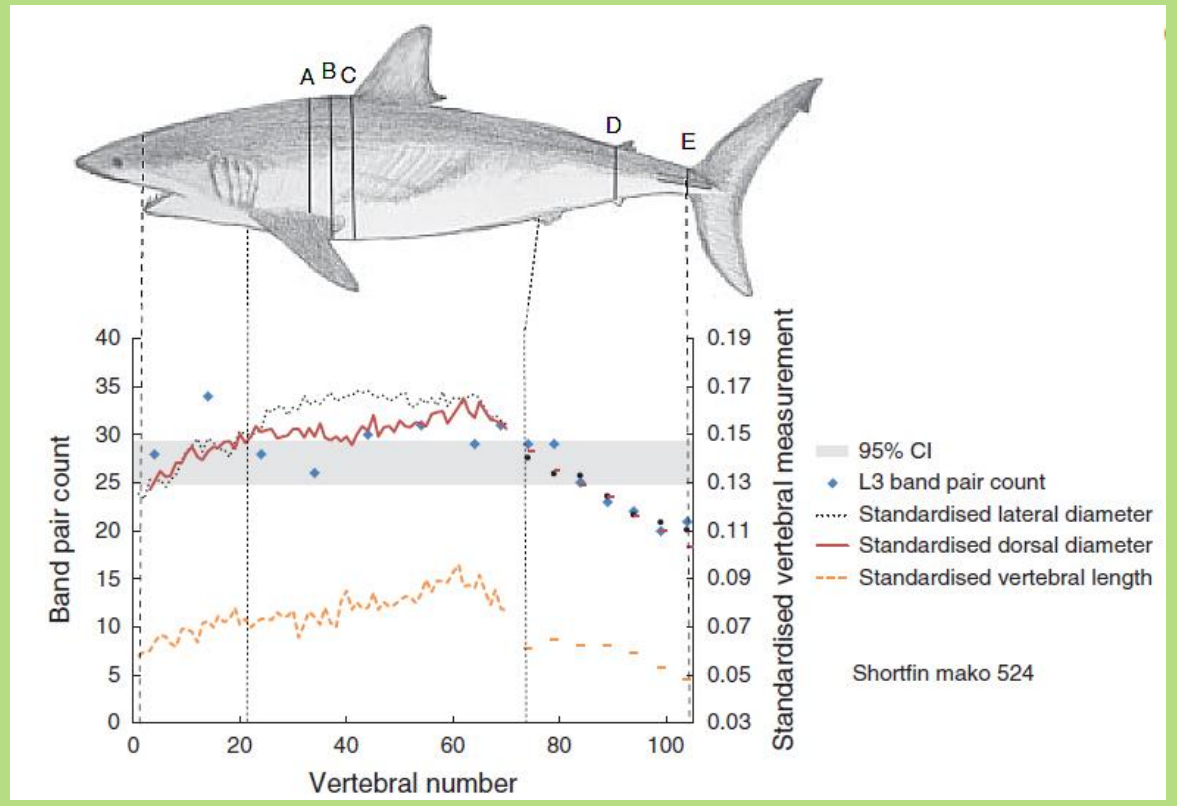


Fig. 4 - Band pair counts and measurements related to position along the vertebral column at Girths A–E for the largest shortfin mako *Isurus oxyrinchus* column specimen (343.0 cm FL).

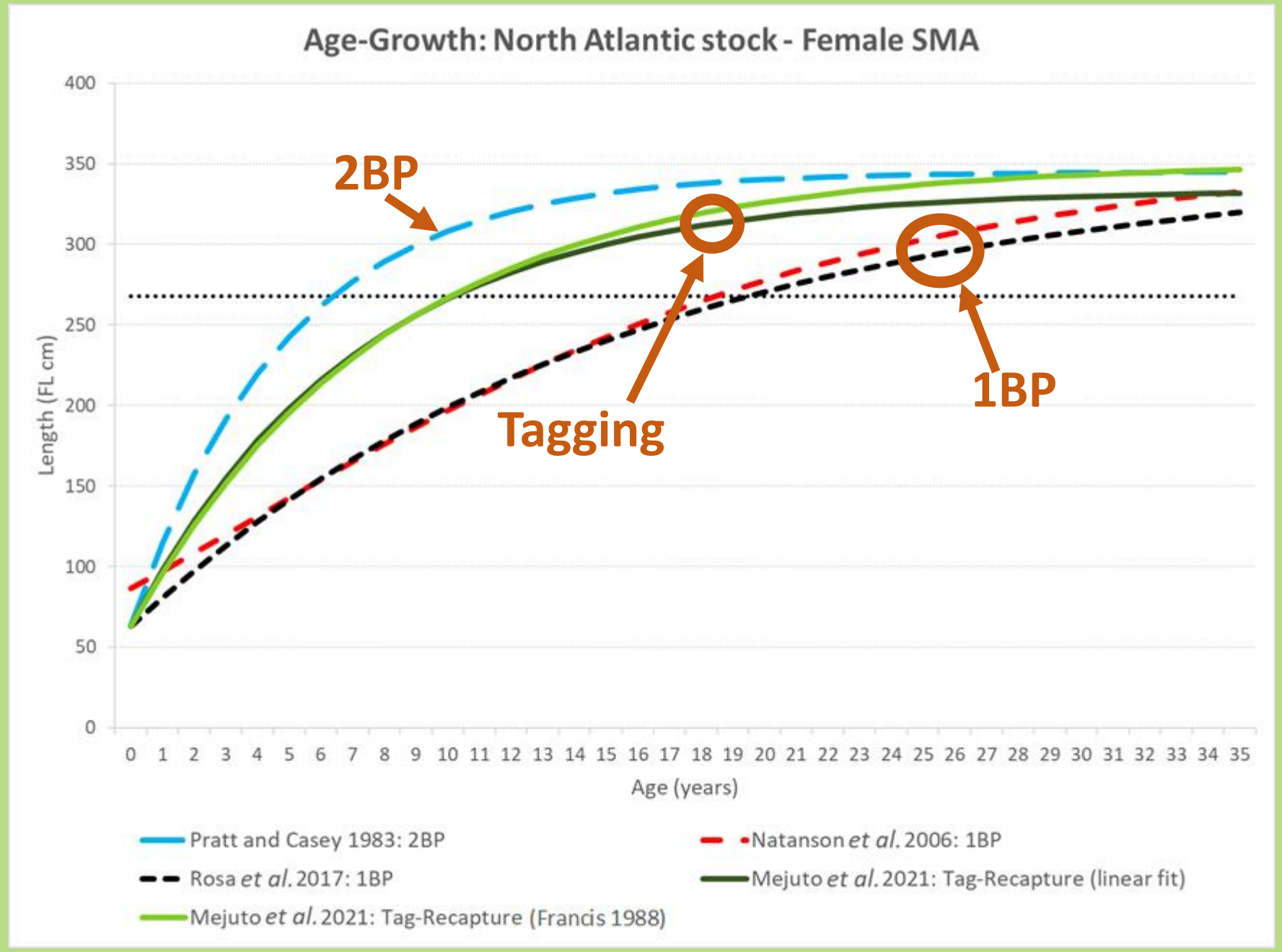
Natanson *et al.* 2018

Age and growth of sharks: do vertebral band pairs record age?

- No study to date has determined the mechanism driving band pair deposition, although feeding, migration, temperatura and photoperiod are among several possibilities.
- Shortfin mako have **varying band pair counts along the vertebral columna** and **ontogenetic changes** in band pair deposition.
- Band pair deposition is more **closely correlated with girth than length**. Band pair deposition rates change along the column in adults when growth in length slows and girth increases.
- None has completely validated band pair deposition through an entire lifespan.
- It is worth critically examining past studies on vertebral ageing, and future studies should perhaps asume that pair deposition is not triggered by a time-related event, but rather to growth, which may coincidentally correspond to time on some centra along the columna of a species for a portion of their lifespan.

Age-Growth curves

North Atlantic SMA stock



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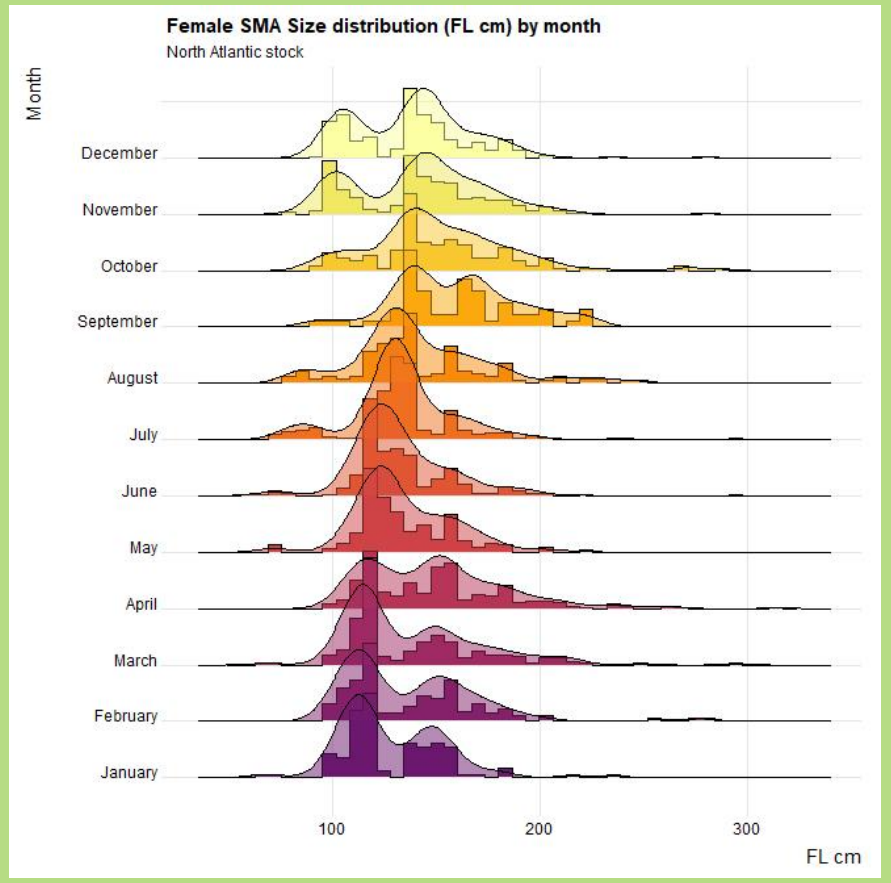
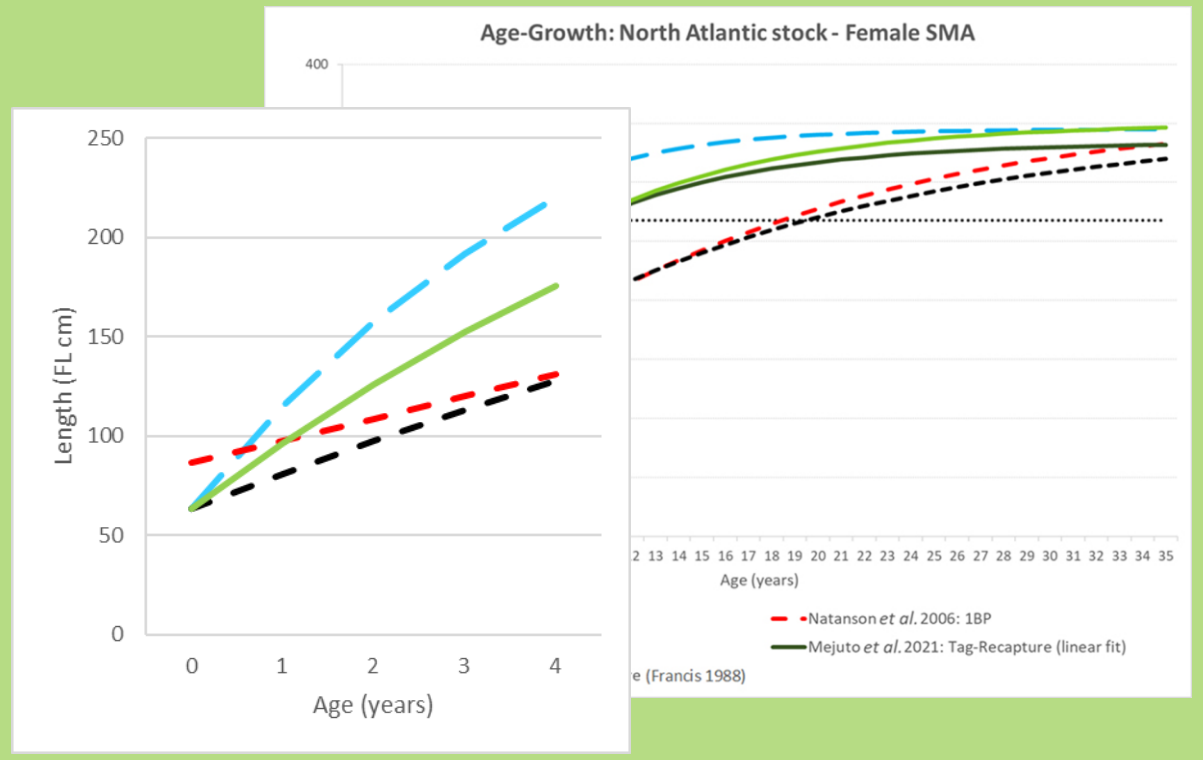


Data source: Fernández-Costa *et al*. (SCRS/2025/027)

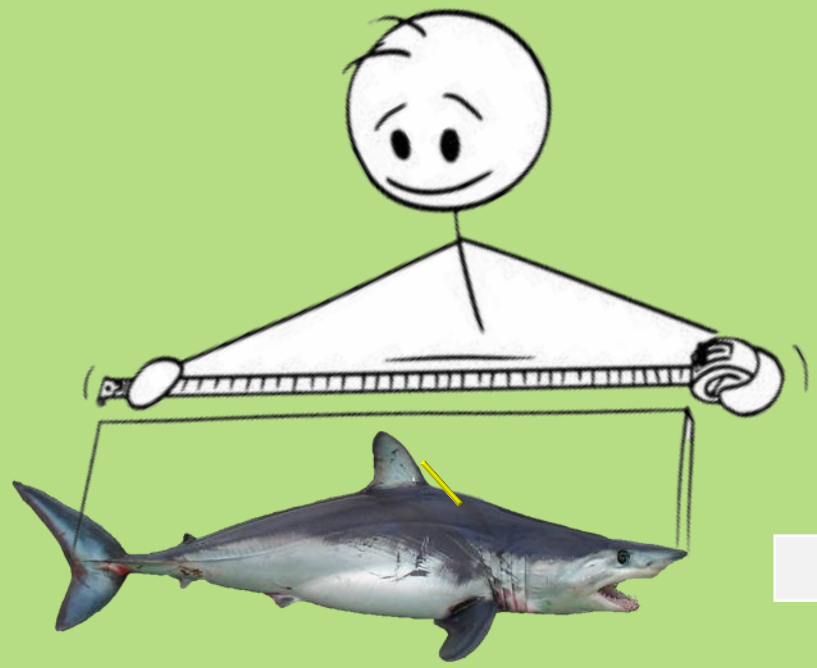


	Δ 1st yr	Δ 2nd yr	Δ 3th yr	Δ 4th yr
Lenght-Frequecy/Month	**~ 40**	**~ 35**	**~ 25**	
Pratt and Casey 1983	**51.74**	**42.23**	**34.47**	**28.14**
Natanson *et al.* 2006	10.82	11.10	11.28	11.37
Rosa *et al.* 2017	17.81	16.71	15.67	14.70
Mejuto *et al.* 2021	**33.47**	**29.57**	**26.12**	**23.07**

Age-Growth curves

North Atlantic SMA stock

	Δ 1st yr	Δ 2nd yr	Δ 3th yr	Δ 4th yr
Lenght-Frequecy/Month	~ 40	~ 35	~ 25	
Pratt and Casey 1983	51.74	42.23	34.47	28.14
Natanson *et al.* 2006	10.82	11.10	11.28	11.37
Rosa *et al.* 2017	17.81	16.71	15.67	14.70
Mejuto *et al.* 2021	33.47	29.57	26.12	23.07
Tag-recapture	**Mean growth = 16.25 cm/yr**			



Female 105cm FL

13.5 years

325cm FL

Age-Growth curves

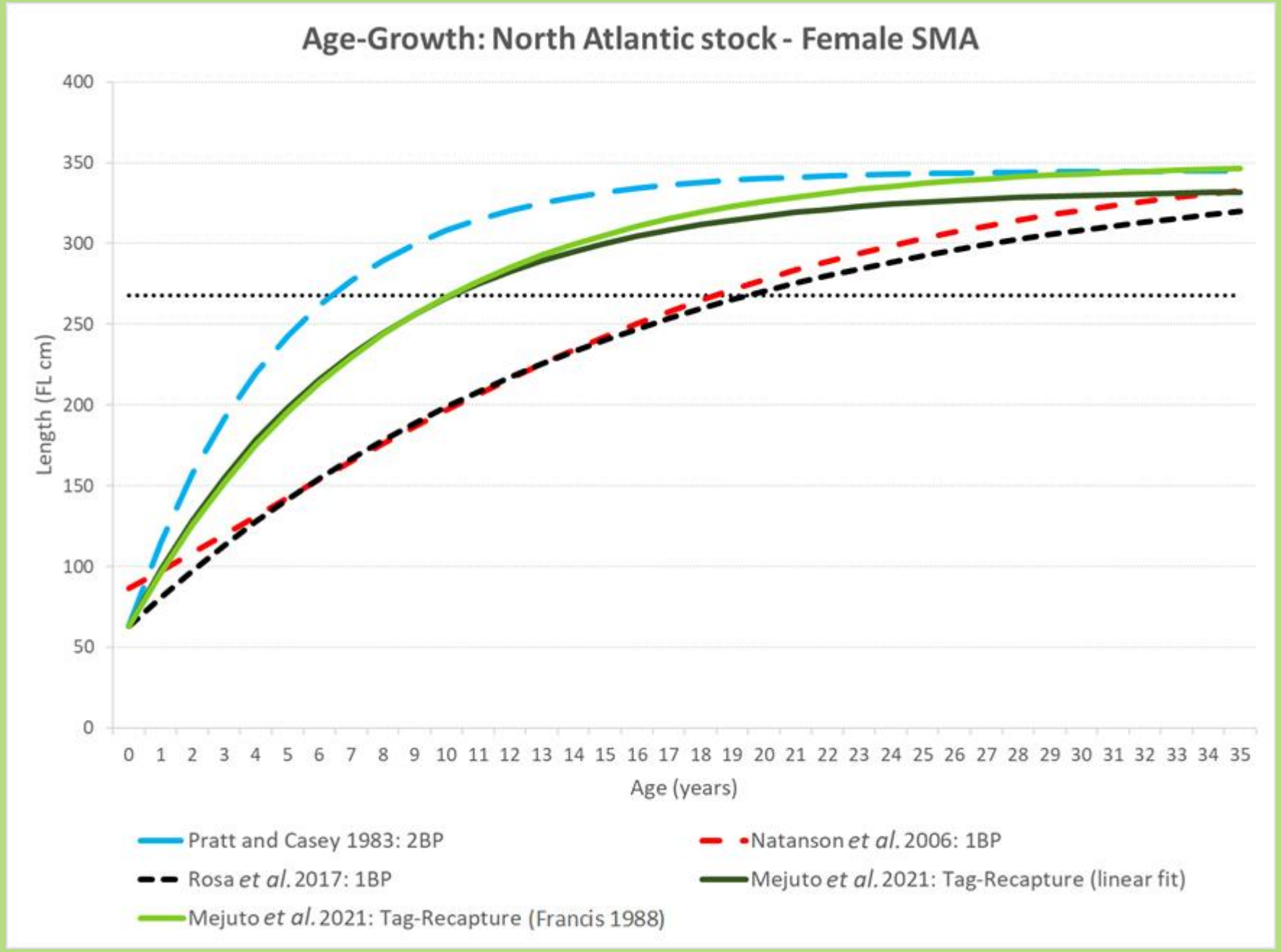
North Atlantic SMA stock

If SMA females mature at

275 FL_{OTB}

Age at maturity varies from **6.5** yr to **19.5** yr depending on the study.

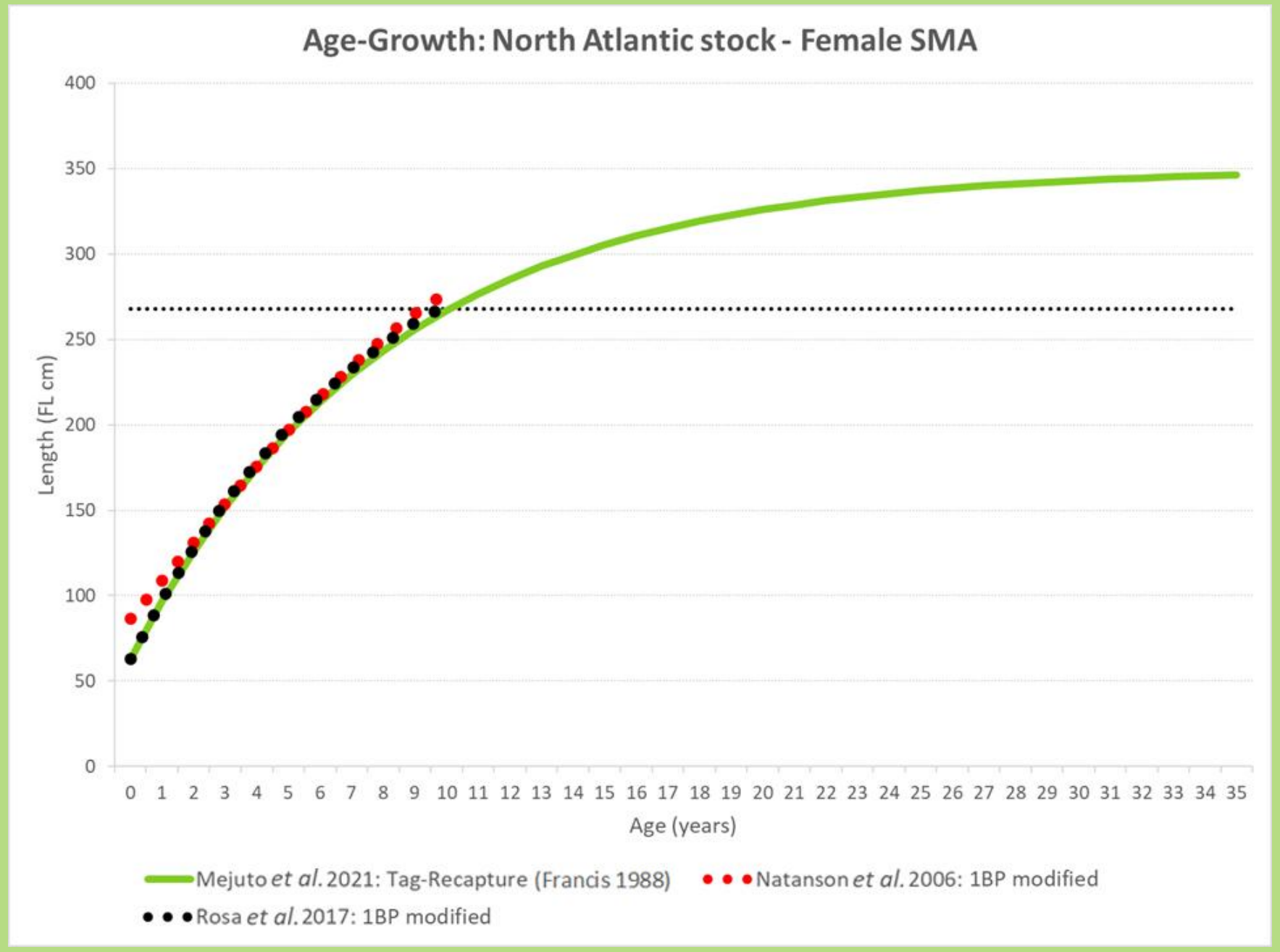
Maturity at **10** years in the tag-recapture model of Mejuto *et al.* 2021.



Age-Growth curves

North Atlantic SMA stock

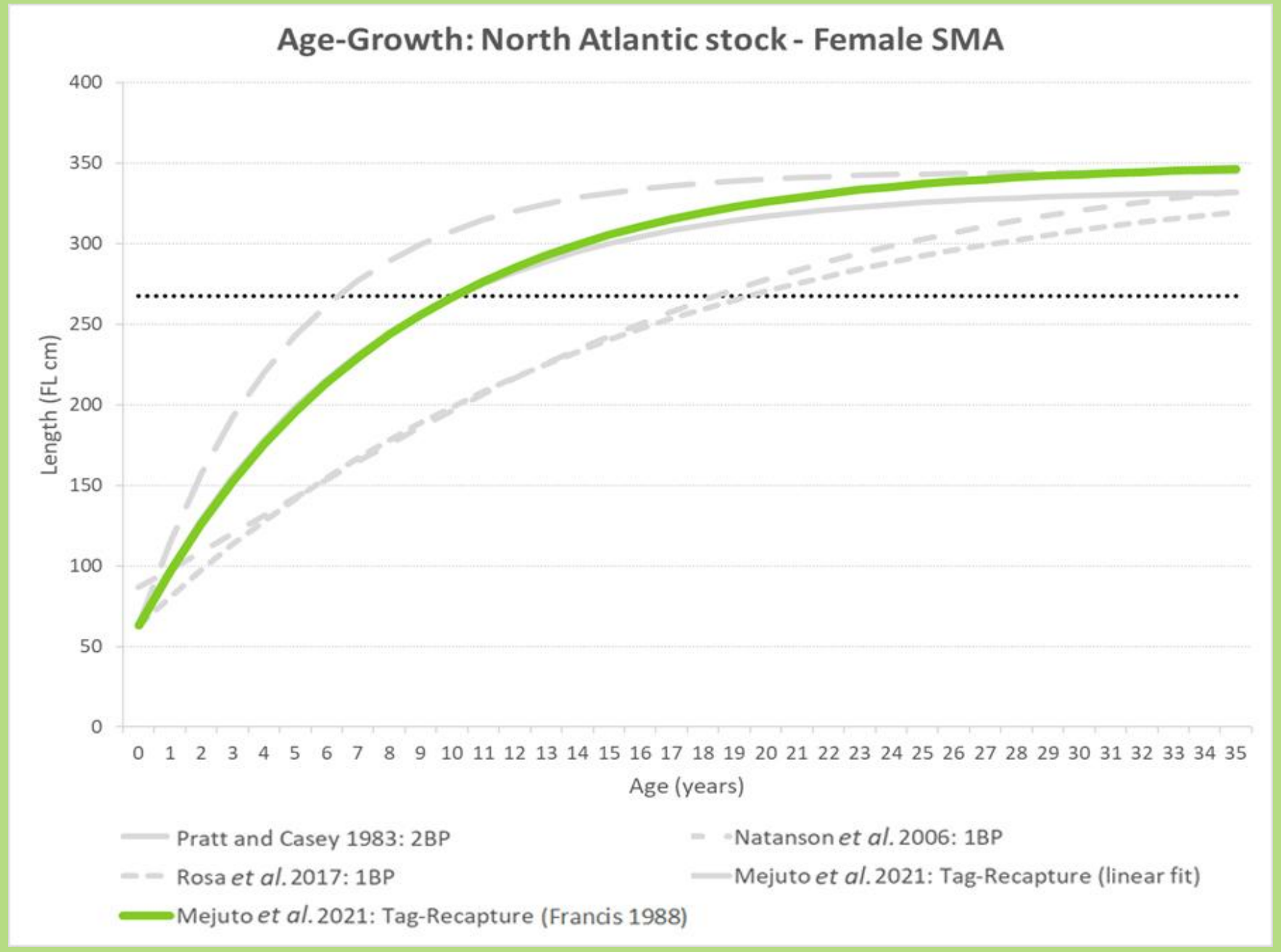
Transforming the 1BP female growth models to 2BP up to 10 years….



Age-Growth curves

North Atlantic SMA stock

We consider the tag-recapture (Francis 1988) model from the paper of Mejuto *et al.* 2021 to be the most reliable model for estimating the growth of female SMA.



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Muchas gracias por su atención
Thank you for your attention
Merci beaucoup pour votre attention