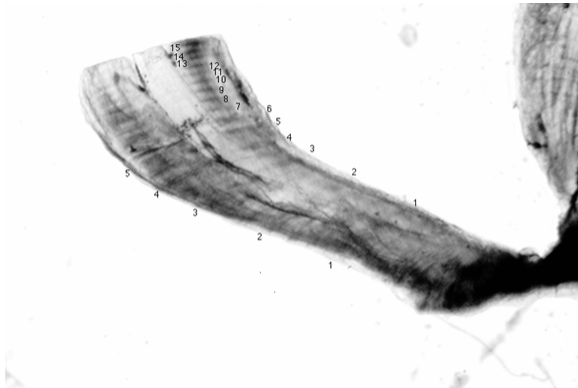




Fish Ageing Services



# CHALLENGES IN THE 'ART' OF AGEING: A BRIEF HISTORY OF 20 YEARS WORKING ON AGE ESTIMATION STUDIES, WITH A FOCUS ON THE DIFFICULTIES ENCOUNTERED IN RECENT AGEING OF BIGEYE FROM THE EPO AND WCPO USING ANNUAL INCREMENT COUNTS IN OTOLITHS



## Background

Started down the path of the otolith back in 1996

- fork in the road moment really

-do a project on age and growth or landscape gardening!

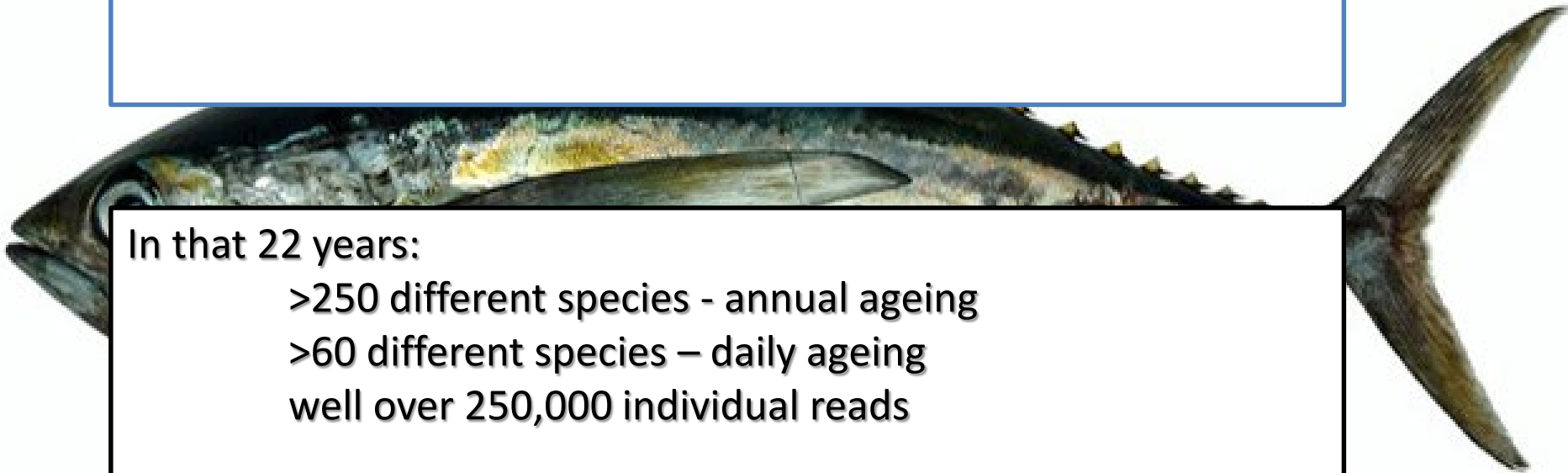
In that 22 years:

>250 different species - annual ageing

>60 different species – daily ageing

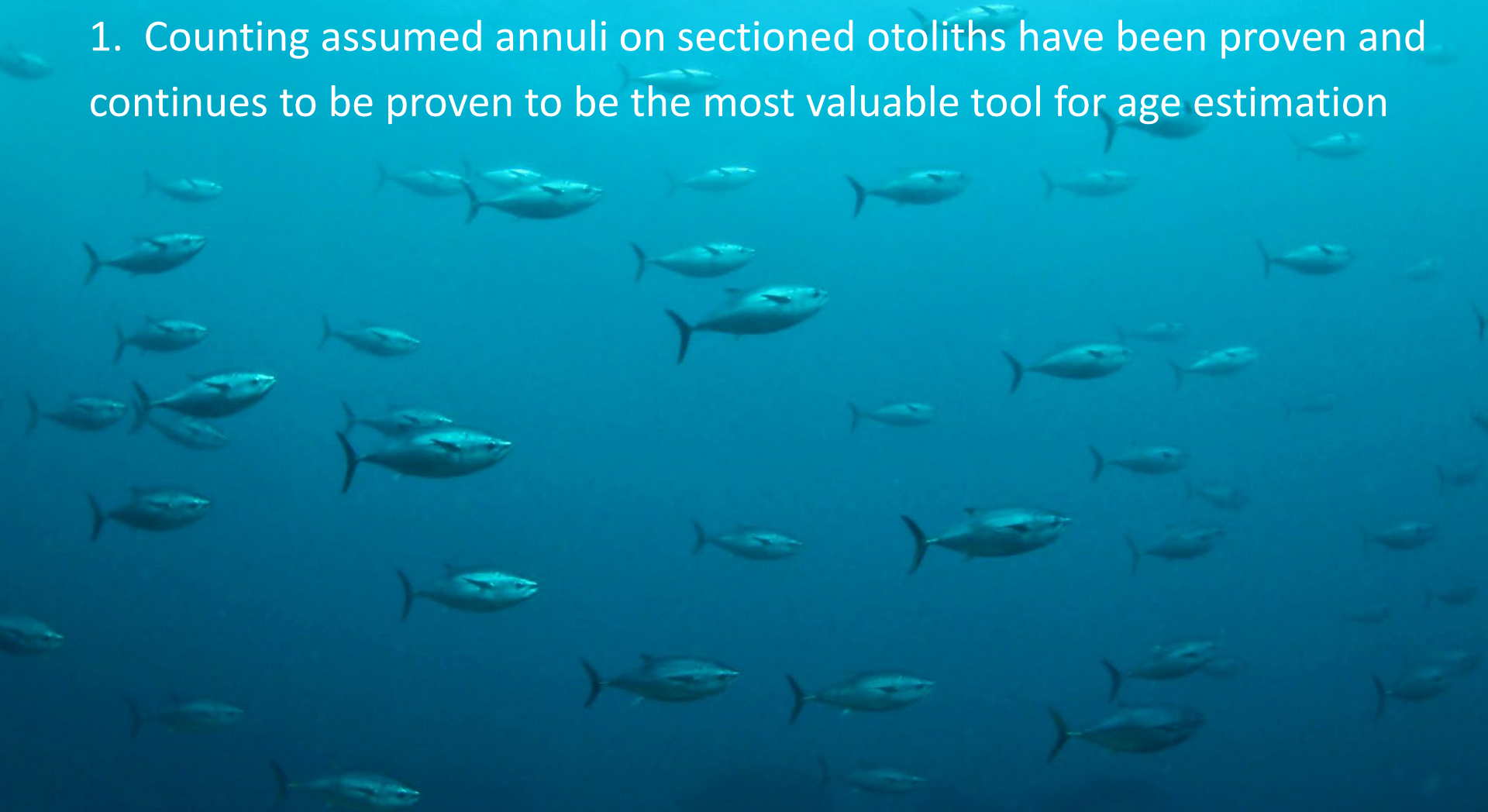
well over 250,000 individual reads

Over that time I've made some observations:



# 6 main observations

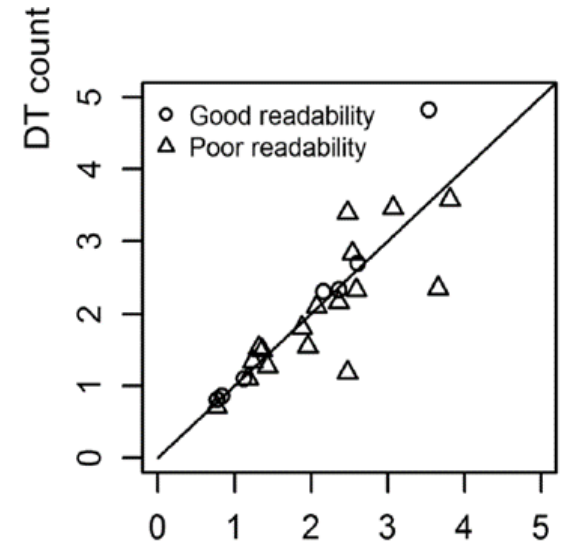
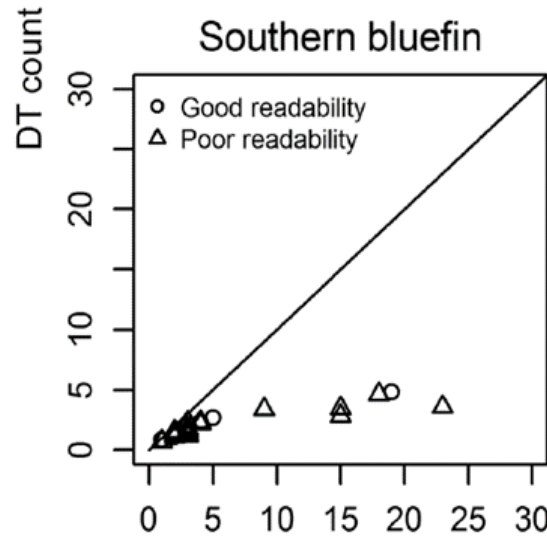
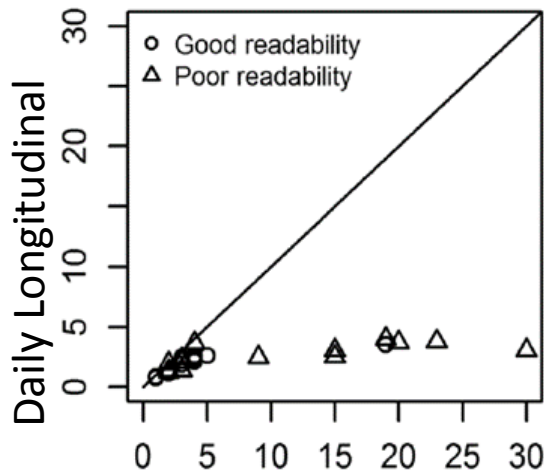
1. Counting assumed annuli on sectioned otoliths have been proven and continues to be proven to be the most valuable tool for age estimation



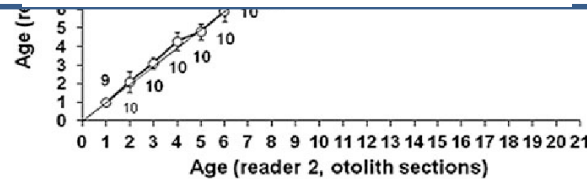
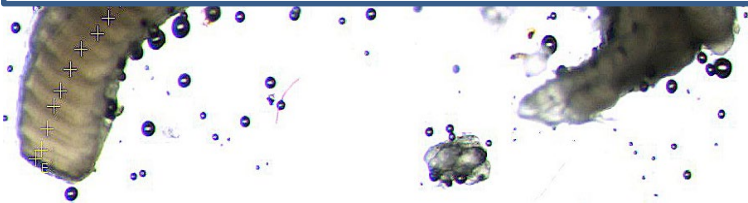
# 3 examples of structure comparison



A  
21  
20  
19  
18  
17  
16



Annual Transverse (yrs)



Jessica Farley et al. (2016) Determination of swordfish growth and maturity relevant to the southwest Pacific stock. CSIRO Oceans & Atmosphere, Hobart, 2016. ISBN 978-1-4863-0688-6

Tariche et al. (2015). Age estimation and growth pattern of the grouper *Cephalopholis taeniops* (Epinephelidae) off the Cape Verde Archipelago, north-west Africa. *Journal of the Marine Biological Association of the UK*. 95. 1-11.



# 6 main observations

1. Counting assumed annuli on sectioned otoliths have been proven and continues to be proven to be the most valuable tool for age estimation

2. Interpretation of annuli can be difficult

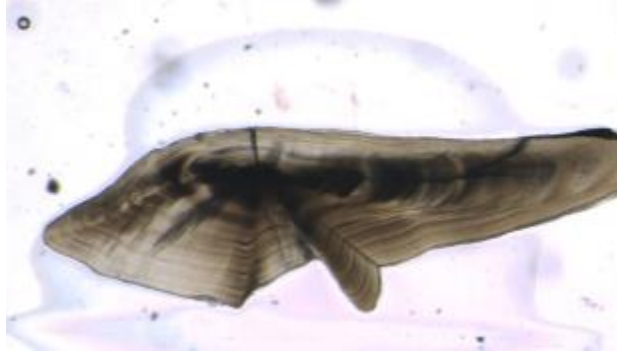
> 80% of the species we have dealt with would be classified as medium or hard. Unfortunately there are very few really good ones.

# 3 examples:

easy

medium

hard



# 6 main observations

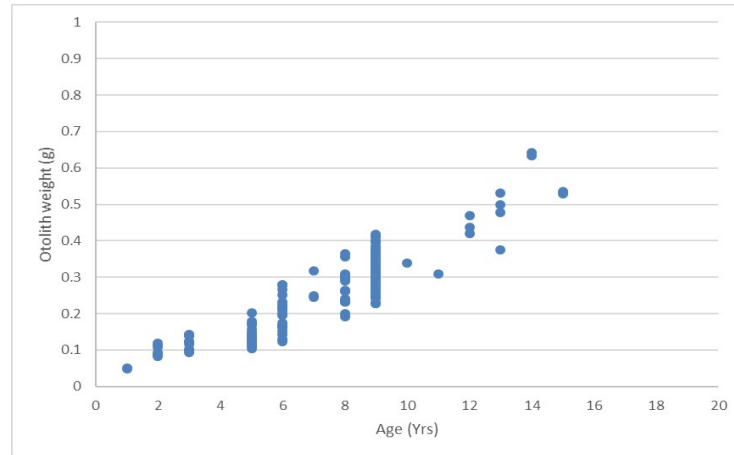
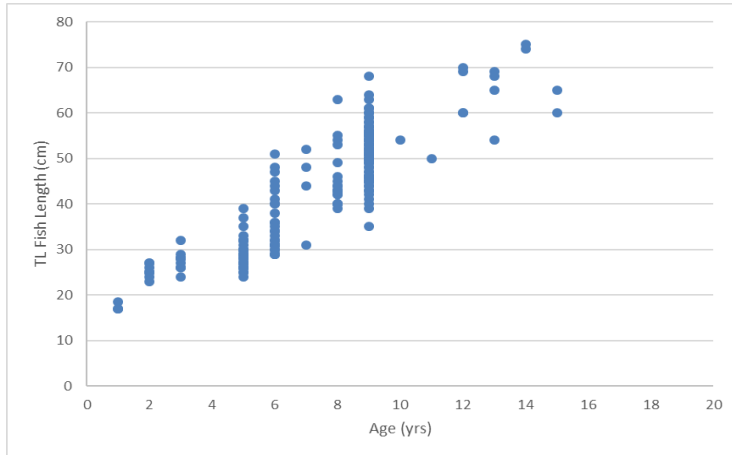
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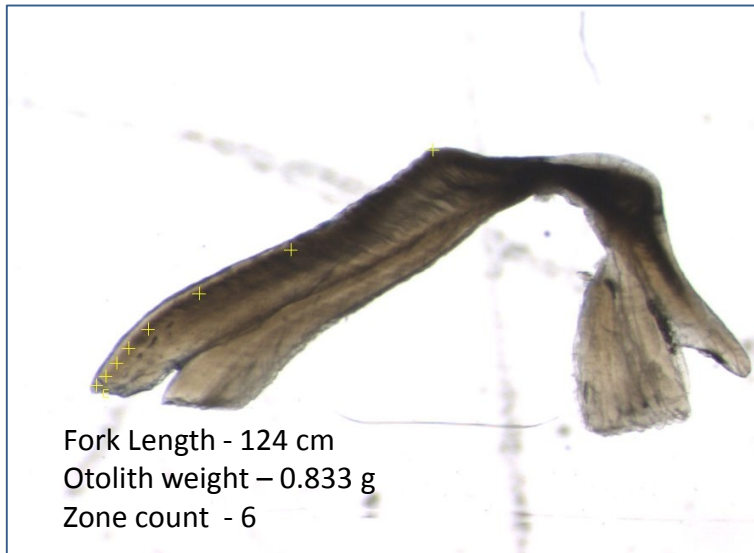
> 80% of the species we have dealt with would be classified as medium or hard. Unfortunately there are very few really good ones.

3. Growth can be very different between individuals of a species

# Difference in growth



Pink Snapper - *Chrysophrys auratus*

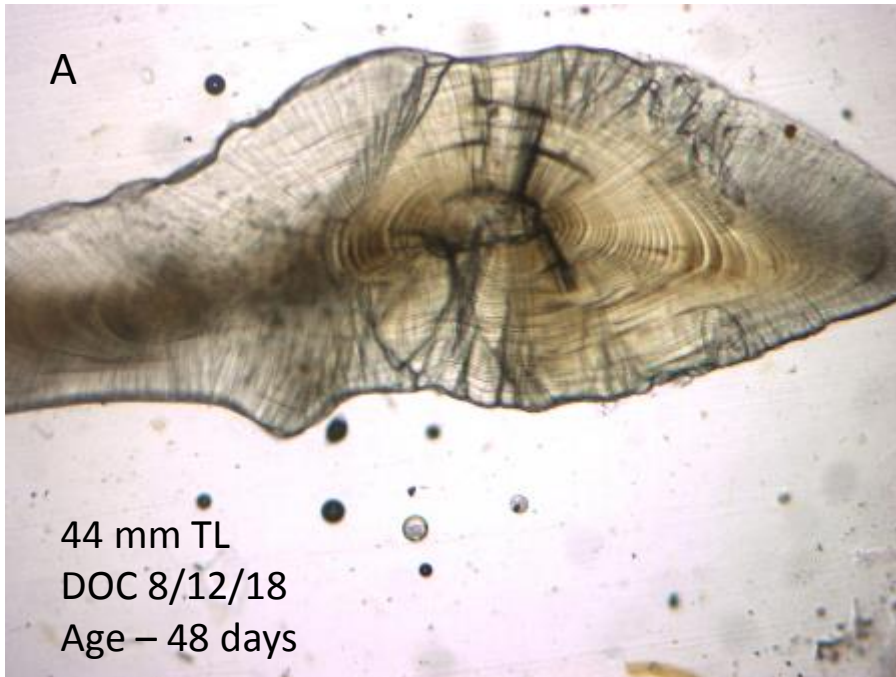


WCPO Bigeye Tuna

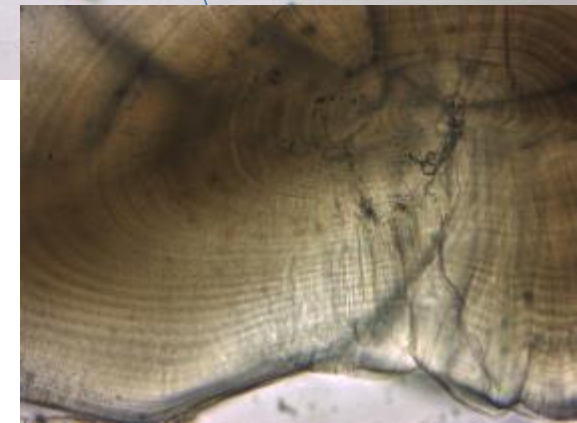


# We also see this on a daily level

Australian freshwater fish - Golden Perch (*Macquaria ambigua*) -



Same system, different growth. Likely from different flow event.



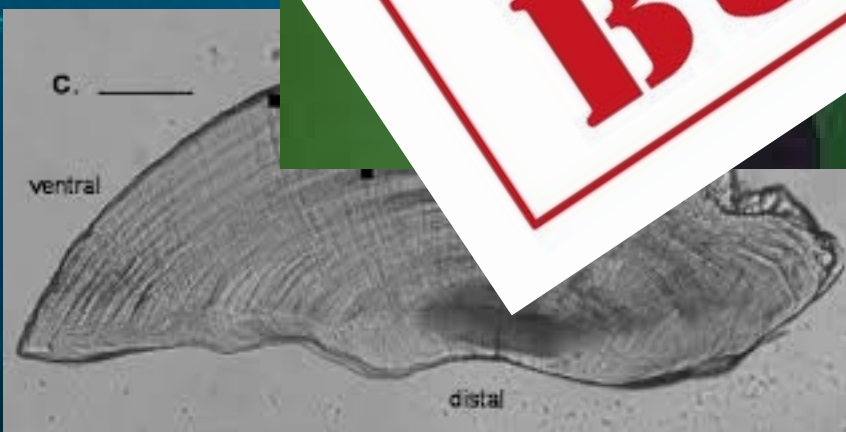
# 6 main observations

1. Counting assumed annuli on sectioned otoliths has not been proven and continues to be proven to be the most inaccurate age estimation

2. Interpretation of otolith microstructure is often confused as a result of the presence of multiple growth zones in otoliths of many species

3. Growth rates of otoliths are often assumed to be constant over the life span of a fish

4. Tropical fish otoliths are often assumed to be



AGE IN YEARS FROM OTOLITHS OF ADULT TROPICAL FISH A.J. FOWLER South Australian Research and Development Institute

# Latitudinal effect

- Distribution further away from the equator = easier to read/longer lived-slower growing
- Closer to the equator = difficult to read/shorter lived-faster growing



- Q/ If there is a latitudinal gradient effect is there also a longitudinal effect?  
I know some researchers have looked at growth of the same species located in different parts of the world, but what about across the one ocean?



# 6 main observations

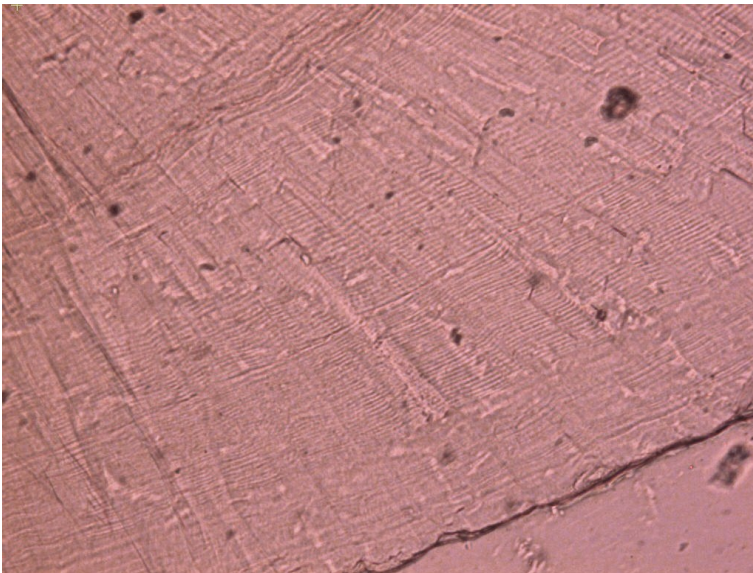
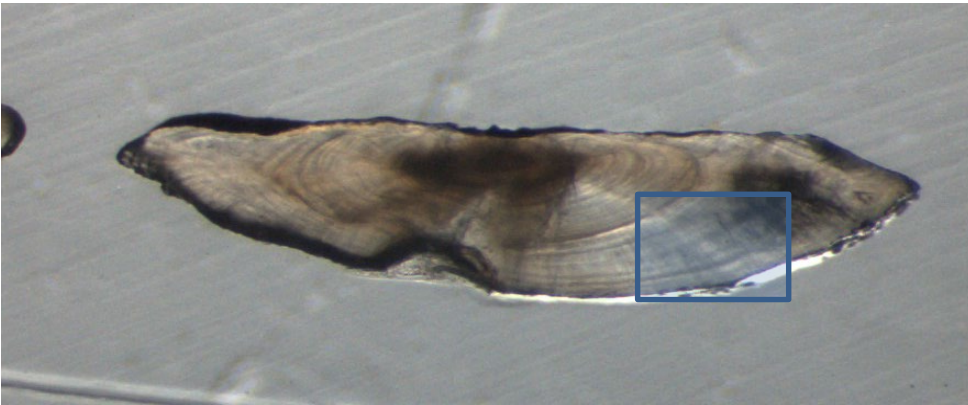
1. Counting assumed annuli on sectioned otoliths have been proven and continues to be proven to be the most valuable tool for age estimation
2. Interpretation of annuli can be difficult
  - > 80% of the species we have dealt with would be classified as medium or hard. Unfortunately there are very few really good ones.
3. Growth can be very different between individuals of a species
4. Tropical vs Temperate.....slight myth
5. Daily ageing is a very useful tool in the process of developing an annual ageing methodology



# Daily ageing

- The main uncertainty with the utility of microincrement counts is the question of whether the daily zones are laid down continuously throughout the year .

Note: B Morales- Nin (1988).

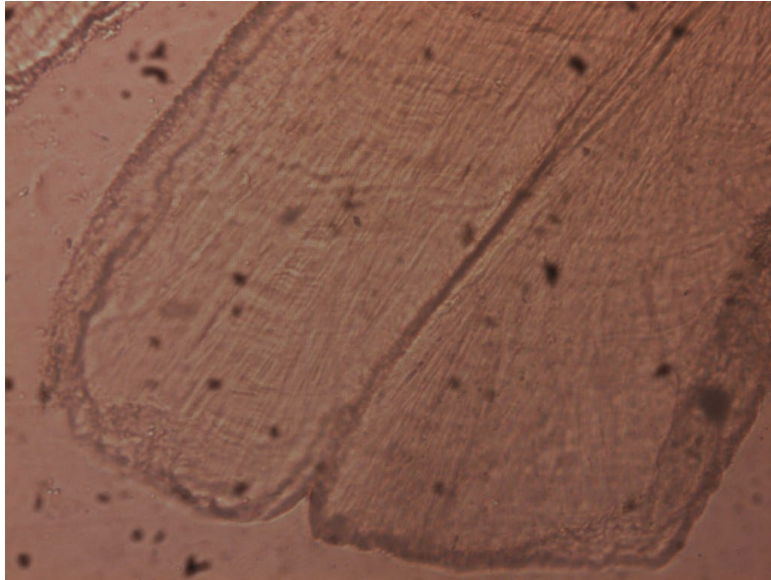


*Acanthopagrus butcheri* - 129 assumed daily zones from hatch mark to first check, 120 days from first check to edge. 10-12 microincrement counted in first opaque check mark. Total daily zones = 261

Annual age 1.785 yrs (651 days).

Difference = 390 days

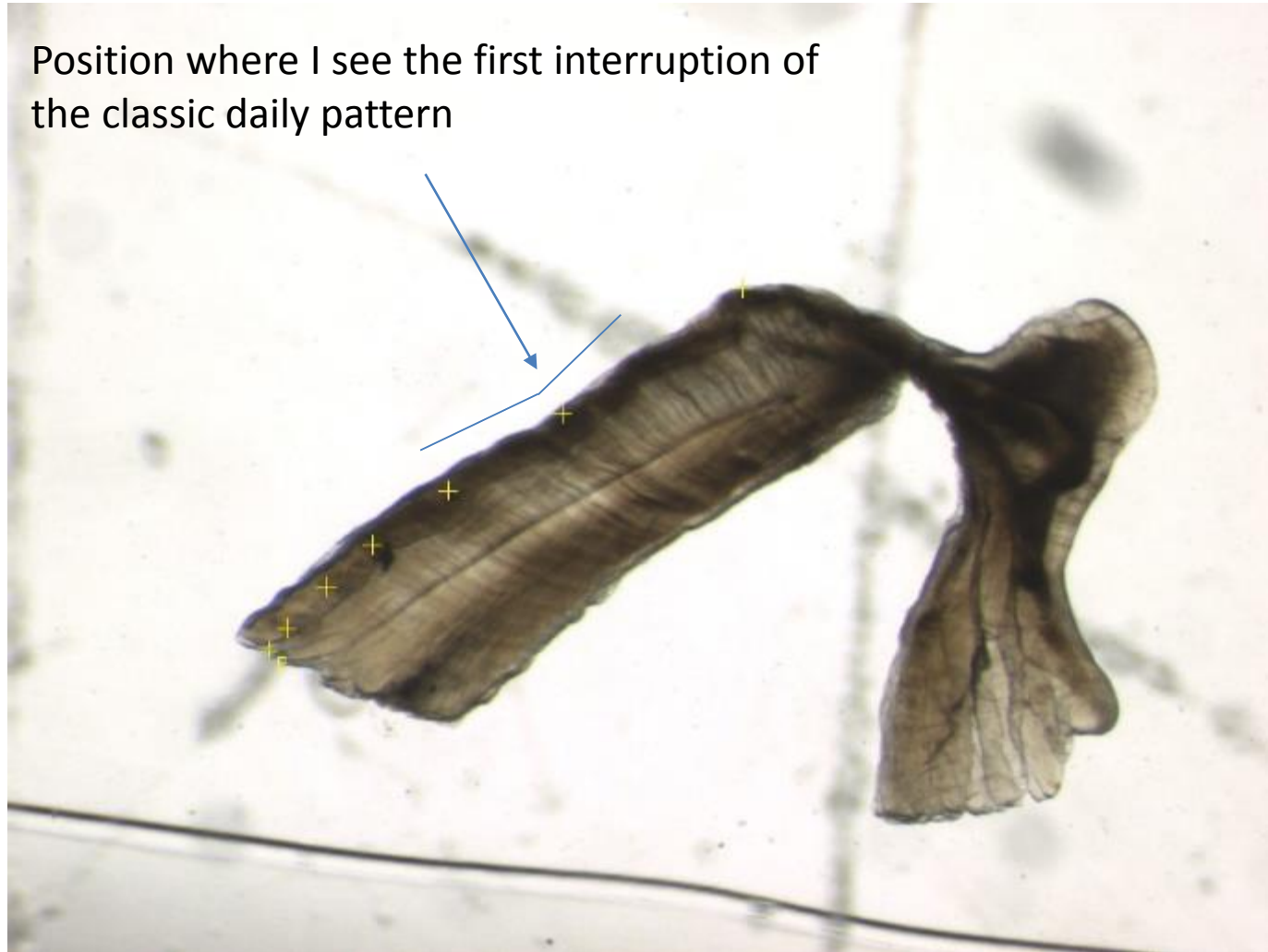
- Daily zone can still be detected on larger (presumably older) fish in some parts of the outer otolith structure
  - Yellowfin with a annual zone count of between 5- 6.



- Southern Bluefin Tuna estimated at 23 yrs showed an average of 30 clear daily like zones within the translucent zones in the outer few annuli of the otolith.
  - These zones were similar in width and structure to those in the internal part of the otolith.

## For Bigeye Tuna transverse sections

Position where I see the first interruption of the classic daily pattern





# 6 main observations

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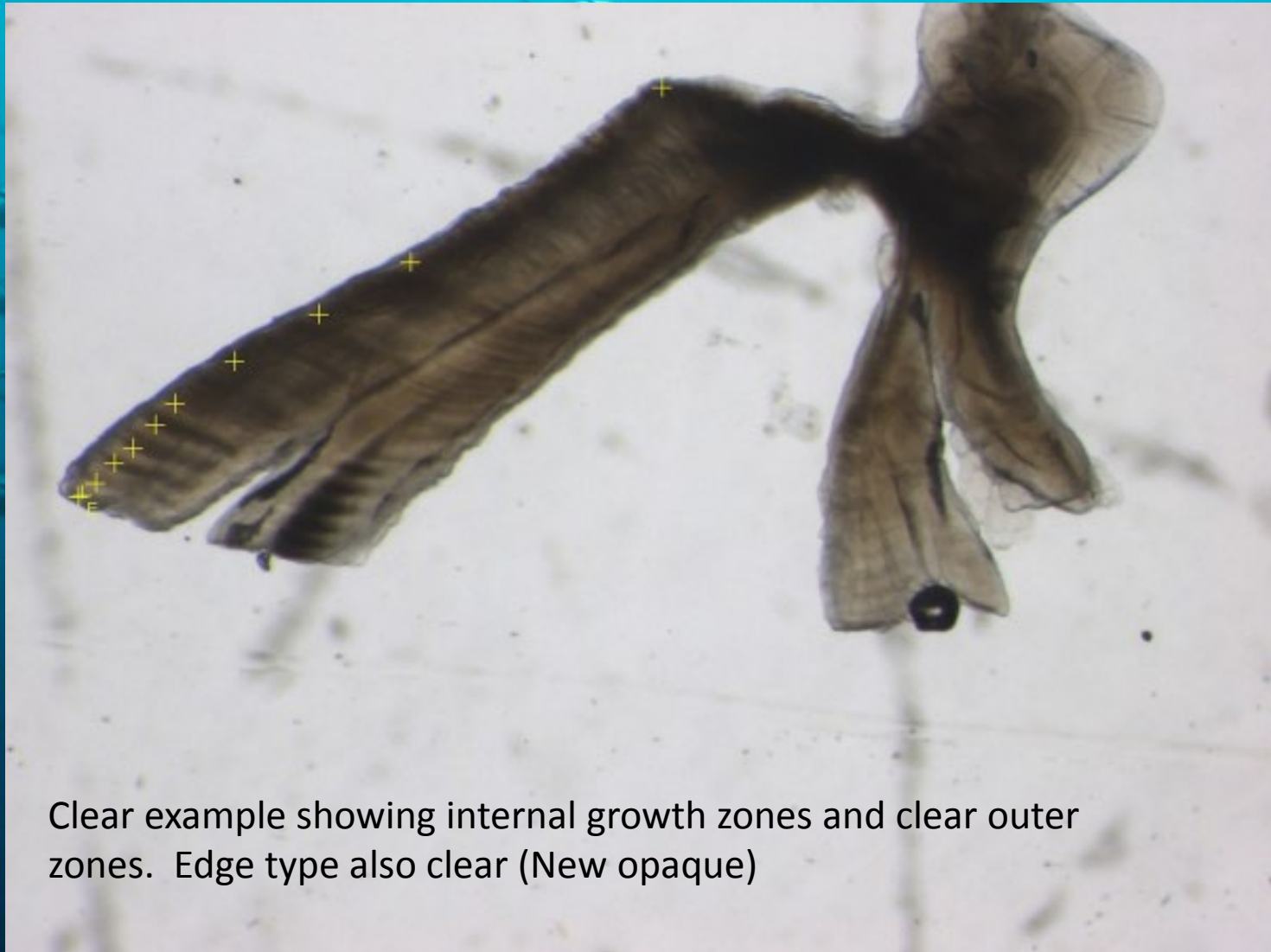
4. Tropical vs Temperate.....slight myth

5. Daily ageing is a very useful tool in the process of developing an annual ageing methodology

6. There is still so much that we don't know about otoliths, the formation of zones, interruptions to growth, somatic vs otolith growth etc



# Bigeye Tuna Ageing



Clear example showing internal growth zones and clear outer zones. Edge type also clear (New opaque)

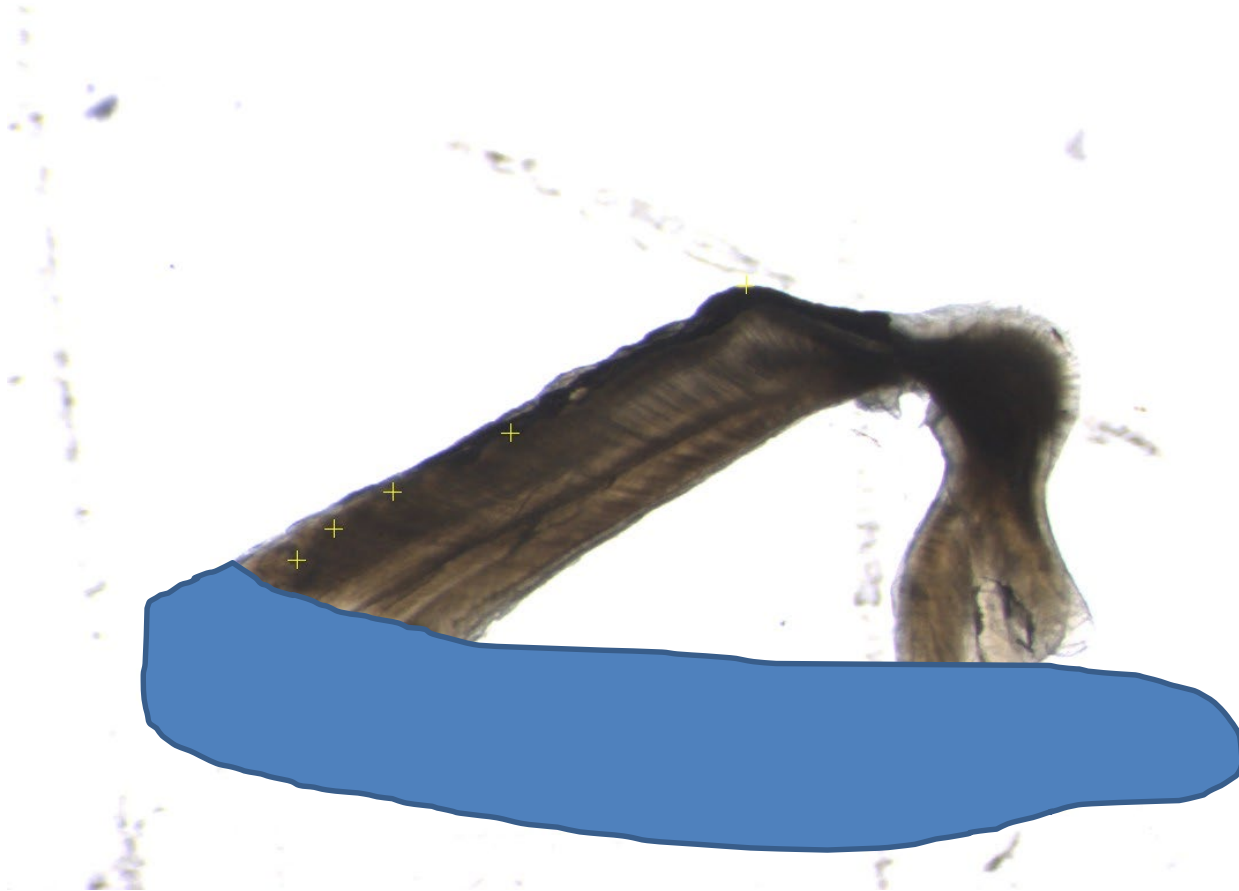
# Challenges

- First 3 opaque and translucent zones are often lacking in definition.



# Often older samples can seem to have clearer internal structure.

But when we remove the outer clear zones?



# Tag-mark and recapture

Fish number	37	57	59	62	63	64	65	66	67	591	2820	
FL at tagging (cm)	72	75	96	109	83	79	78	84	78	80	125	
FL at recapture (cm)	85	128	159	123	94	-	128	129	-	139	157	
Time at liberty after tagging (days)	260 (8.5 mths)	678 (1 yr 10 mths)	2071 (5 yrs 8 mths)	207 (7 mths)	248 (8 mths)	recap. details not known	840 (2 yrs 3 mths)	801 (2 yrs 2 mths)	757 (2 yrs 1 mth)	1120 (3 yrs 1 mth)	2420 (6 yrs 7 mths)	
Number of increments after Sr mark	<b>expected</b>	0 or 1	1 or 2	5 or 6	0 or 1	0 or 1		2	2	2	3	6 or 7
	<b>observed</b>	1	1	5	1	1	1	2	2	2	3	6
Age estimate (this study) *	2	3	8	3	2	2	3	3	3	4	9	
Age at tagging **	1.2	1.3	2.1	2.7	1.6	1.5	1.4	1.6	1.4	1.5	3.18	
Age at recapture **	1.7	3.8	8.6	3.5	2.0	-	3.8	3.9	-	4.8	7.87	
Month of recapture	July	Aug	July	May	June		Jan	Dec	Nov	Feb	May	
distance from Sr mark to margin (cm)	Sr (O) - O	0.36	0.74	1.06	0.25	0.27	0.30	0.72	0.77	0.81	0.67	0.49
	Sr (I) - I	0.26	0.56	0.80	0.15	0.16	0.25	0.54	0.63	0.77	0.50	0.43



\* Estimated by counting annual increments on sectioned sagittal otoliths

\*\* Estimated using results from a study of otolith microincrements and tagging data (Hampton et al. 1998).



# Counting microincrements to verify 1<sup>st</sup> and 2<sup>nd</sup> annuli

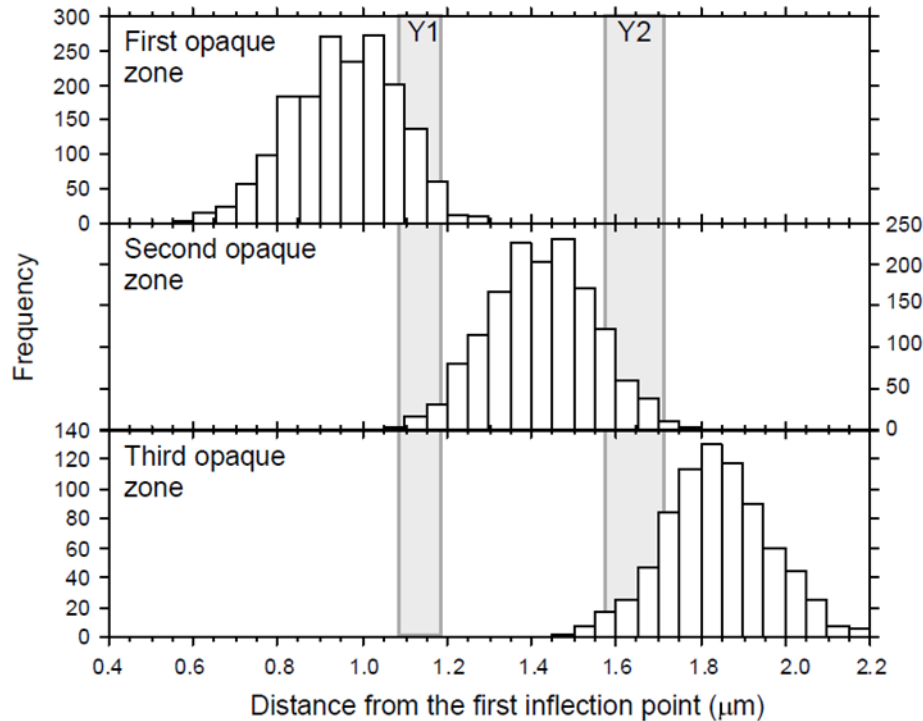


Figure 8.3.9. Histograms of otolith measurements from the first inflection point to the first, second, and third opaque growth zones. All otoliths with measurements were included. Grey stripes represent the 25<sup>th</sup>/75<sup>th</sup> percentile of the median distance to 365<sup>th</sup> increment (age 1; Y1) and the 730<sup>th</sup> increment (age 2; Y2) from microincrement analysis.

# Challenges

- First 3 opaque and translucent zones are often lacking in definition.
- Presence fine structure around the 2<sup>nd</sup> inflection.
  - Trying to interpret what is annual and what is not



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Number of increments after Sr mark	<b>expected</b>	<b>0 or 1</b>	<b>1 or 2</b>	<b>5 or 6</b>	<b>0 or 1</b>	<b>0 or 1</b>		<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>6 or 7</b>
	<b>observed</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>6</b>
Age estimate (this study) *	2	3	8	3	2	2	3	3	3	4	9	
Age at tagging **	1.2	1.3	2.1	2.7	1.6	1.5	1.4	1.6	1.4	1.5	3.18	
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\* Estimated by counting annual increments on sectioned sagittal otoliths.

\*\* Estimated using results from a study of otolith microincrements and tagging data (Hampton et al. 1998).

# Challenges

- First 3 opaque and translucent zones are often lacking in definition.
- Presence fine structure around the 2<sup>nd</sup> inflection.
  - Trying to interpret what is annual and what is not
- Edge type can be difficult to assign in young fish
  - Alternatively, measurements of marginal increment could be as useful.



# Edge type assignment

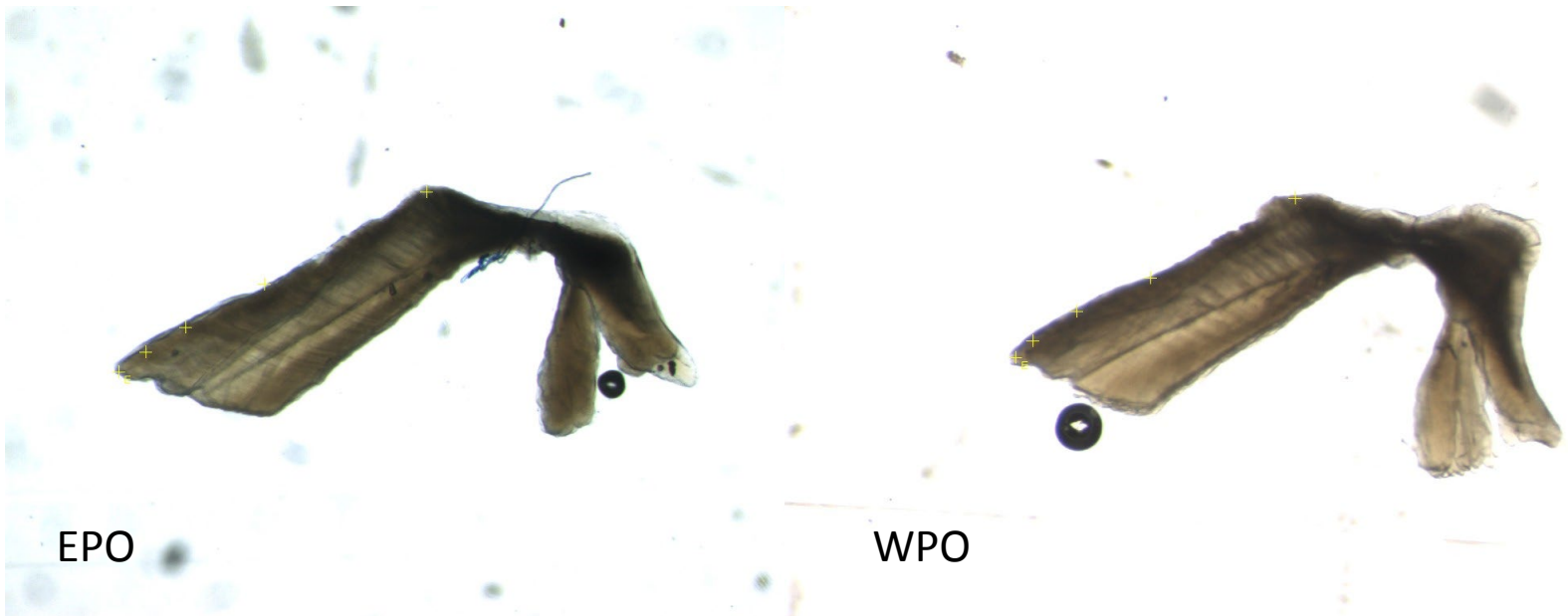
- Some examples.
- Younger can be difficult, older better.



Both EPO samples supplied by IATTC

# But for EPO?

- I have aged approx. 70 samples from IATTC which ranged between a zone count of 0 to 6 . All less than 149 cm – difficult size range to age



- However the otoliths look reasonably consistent between eastern and western. Discussion point?

I have aged another 70 samples of EPO caught fish from NRIFSF



155 cm EPO – 6+



177 cm EPO

-

13+

- Thank you

