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Tag-recapture oxytetracycline-marking experiments to investigate daily increment deposition rate in yellowfin otoliths

Jeanne Wexler

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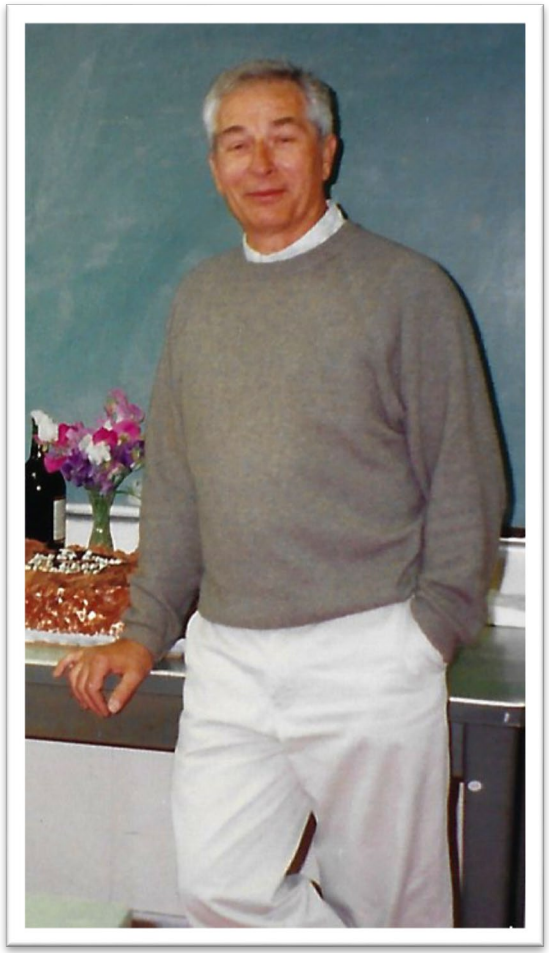
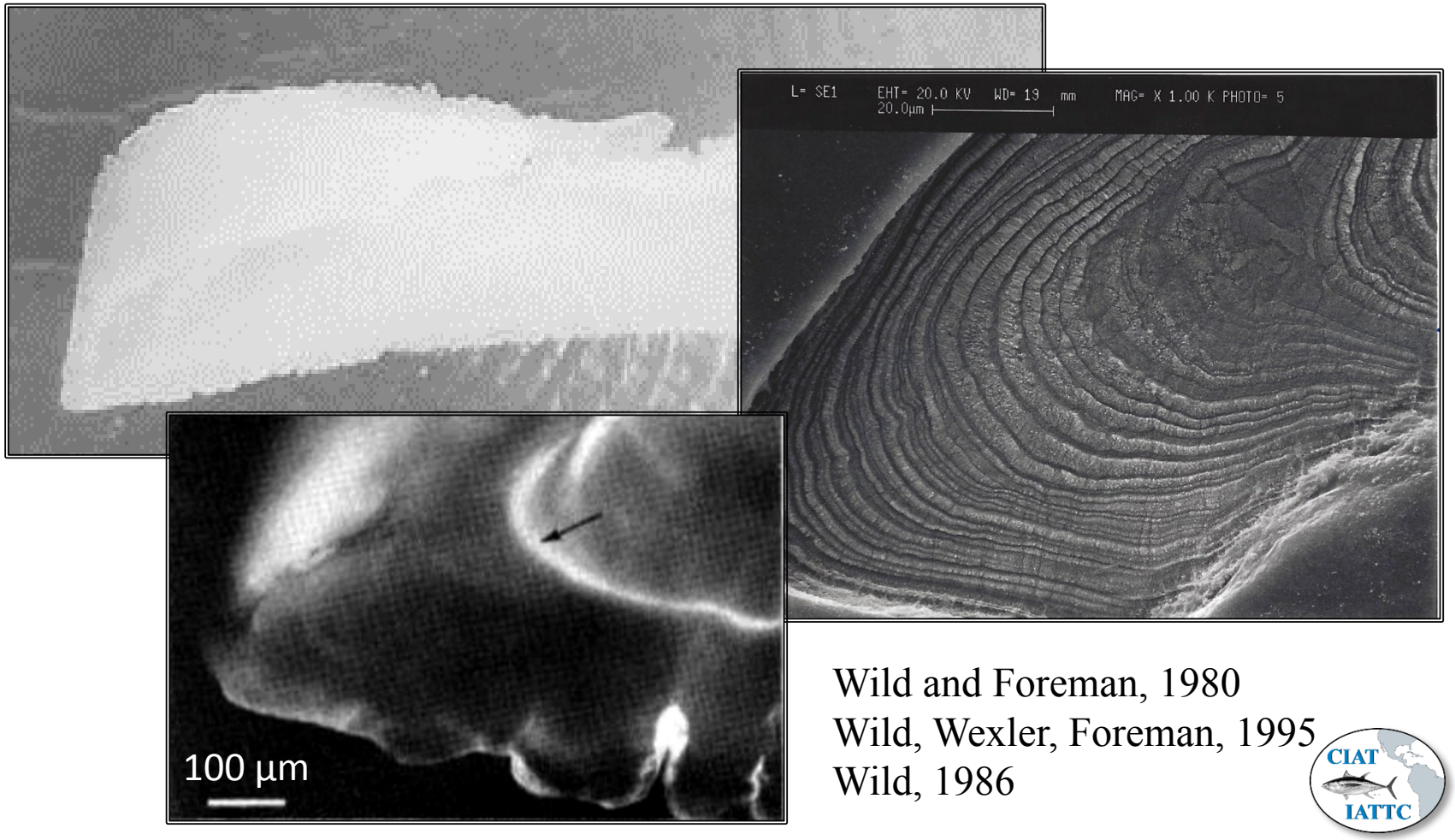
Tag-recapture oxytetracycline (OTC)-marking experiments to investigate daily increment deposition rate in yellowfin otoliths



Alex Wild

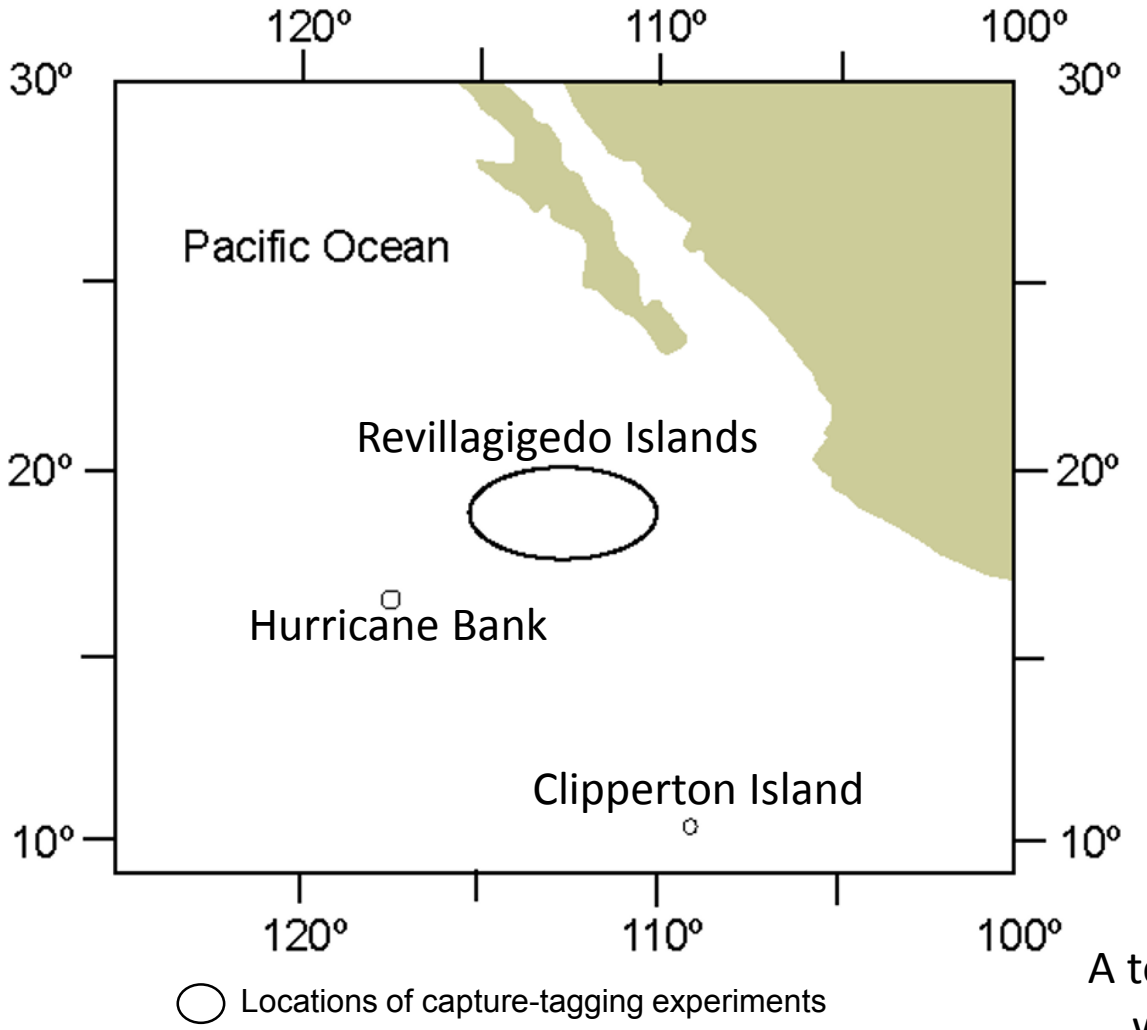


Wild and Foreman, 1980
Wild, Wexler, Foreman, 1995
Wild, 1986

Key results to be discussed from the mark-recapture experiments of 1976 and 1980-81

- Tag-return rates (*i.e.* survival) compared between OTC injected yellowfin and non-injected yellowfin captured from the EPO
- Techniques developed to determine the periodicity of otolith increments
- The relationship between otolith increments and time in the sagittae of yellowfin tuna from the EPO and other oceans
- A different approach in calculating growth rates of OTC-injected yellowfin based on a curvilinear relationship between otolith length and fish length and otolith measurements to and from the OTC mark (to reduce the variance in growth rates)

Tagging experiments 1976-1981



A total of 10,909 yellowfin were captured and tagged and 32% of these were injected IM with 27 $mg \cdot kg^{-1}$ body weight of OTC (100 mg/ml)

FL measured to nearest cm

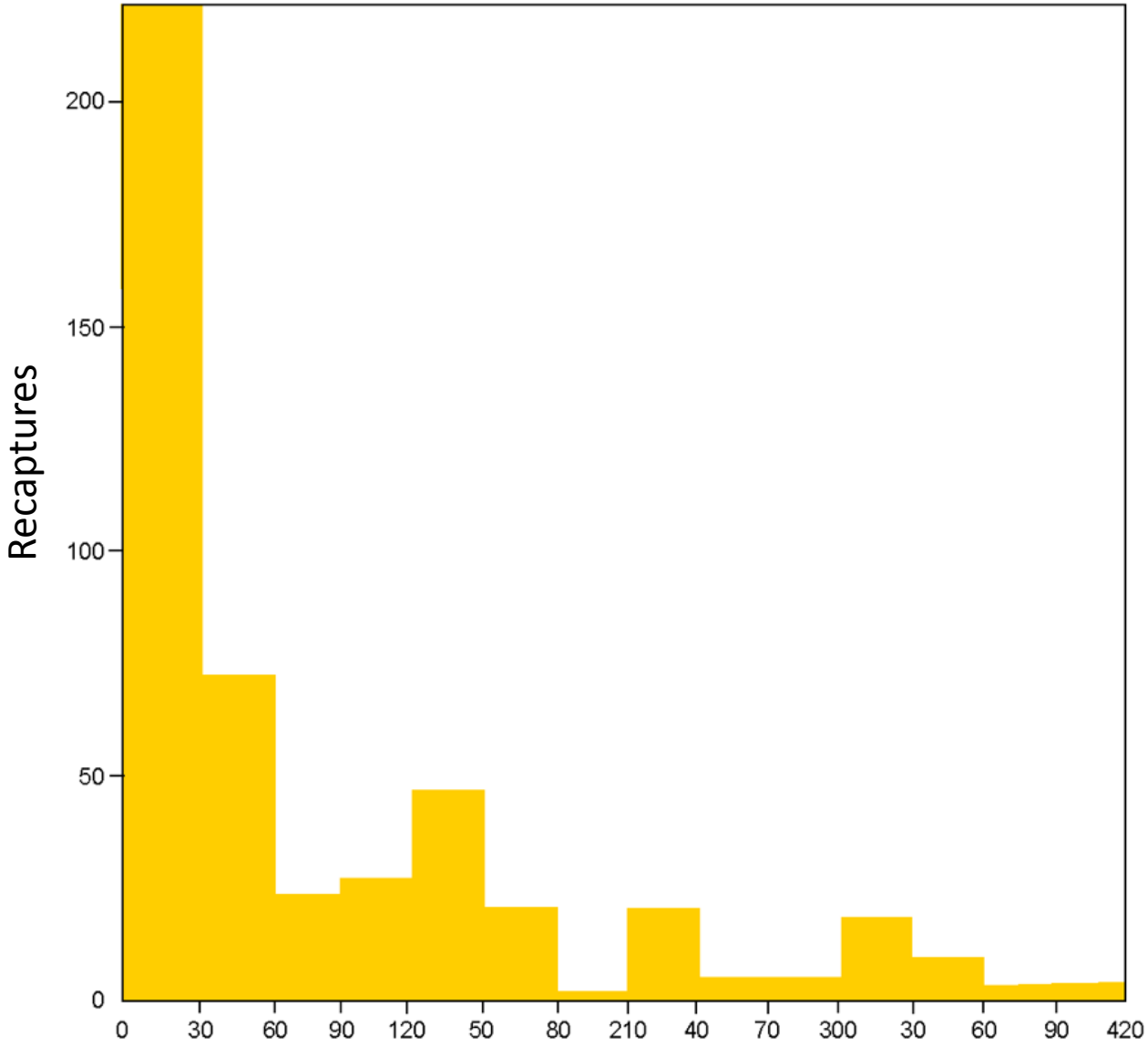
Tagged with a color coded dart tag and released

Recapture returns for tagged yellowfin

Year	Baitboat cruise number		Number Released	Number Returned	Numbers of fish used for validation[1]	Percent recaptured	Return rate (%)	Contingency Test results at 5% level
1976		Control	2,355	1,327		56.3	36	0.08 NS
		OTC	978	562	53	57.5	36	
1980-1981	1093	Control	822	147		17.9	15	5.13 *
		OTC	1,658	377	74 (total from all cruises)	22.7	19	
	1095	Control	3,017	840		27.8	22	69.40 *
		OTC	476	30		6.3	6	
	1096	Control	1,277	294		23.0	19	0.03 NS
		OTC	326	77		23.6	19	

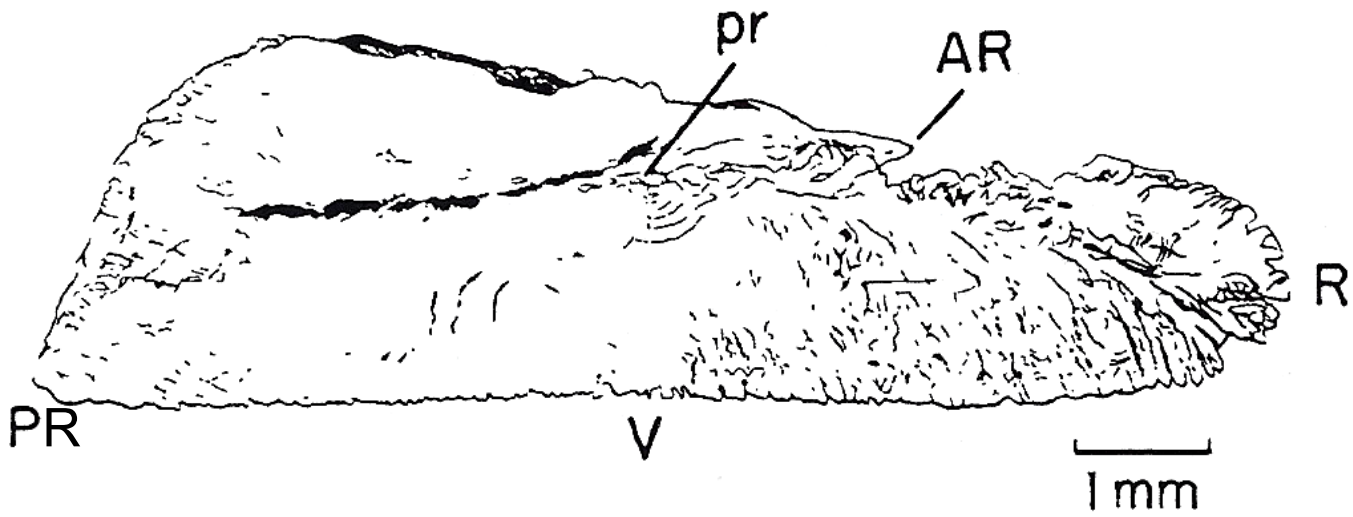
[1] Fish were selected based on the return of both fish and tag, known recapture dates, and a representative range of elapsed time since tagging and injection. (after Wild and Foreman, 1980; Wild, Wexler, and Foreman, 1995)

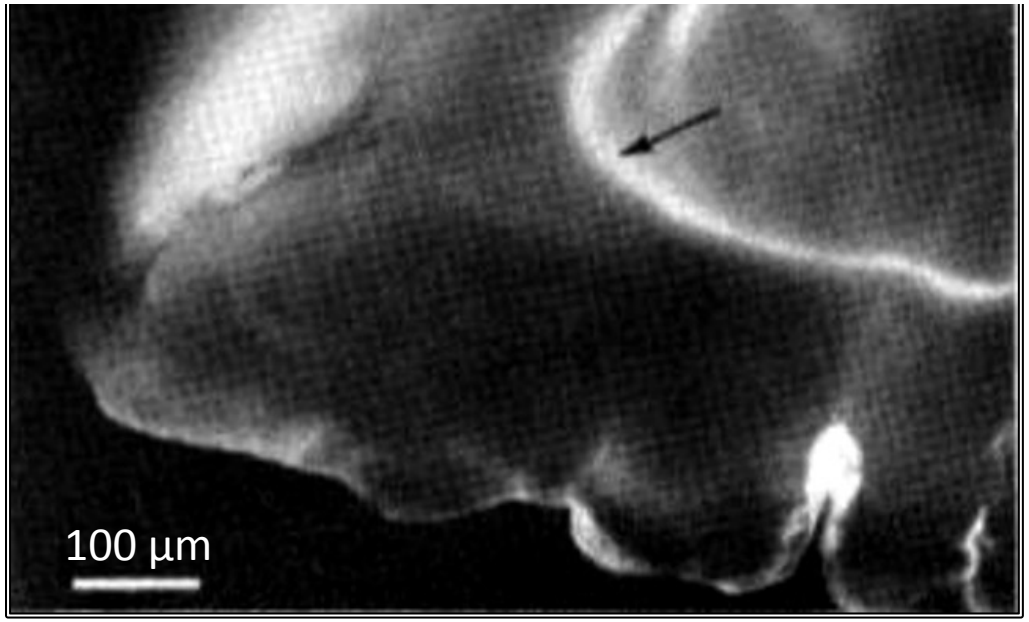
Recapture frequency of OTC-injected yellowfin from 1976 tagging experiment



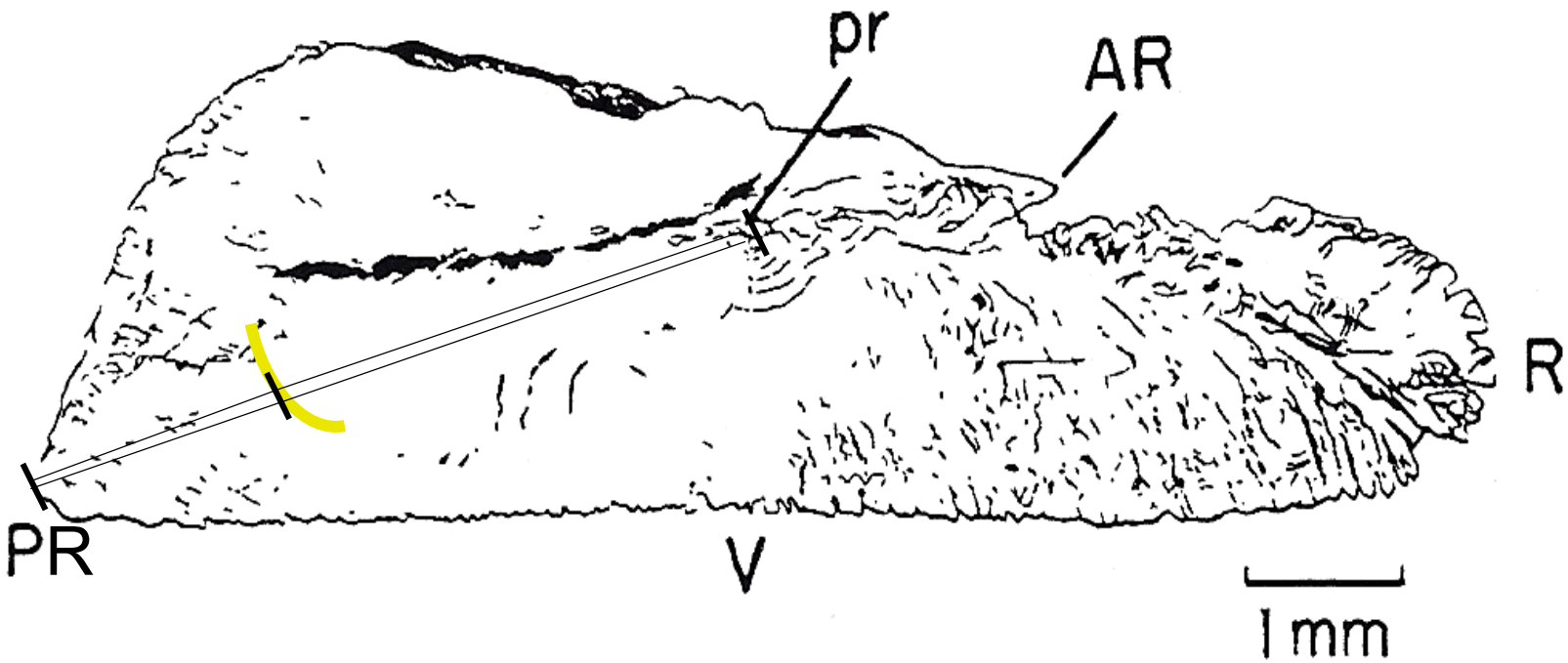
(Wild and Foreman, 1980)

Procedures used for counting increments at the distal surface of sagittae of OTC-injected yellowfin





Yellowfin tuna growth rates determined from otolith measurements and the proportional relationship between PR length and final FL



Growth of yellowfin, in cm per month, derived from tagging measurement data (A) and predicted from otoliths (B)

	1976 (n = 31)		1980-81 (n =41)	
	A	B	A	B
Mean growth rate	2.71	3.16	3.27	3.31
Variance	2.03	1.14	2.02	0.53
Growth rate range	0.1-6.2	1.2-5.1	0.2-6.4	1.7-4.8

Predictive relationship between *FL* (30-160 cm) and the primordium-PR (2.4-9.6 mm) (*P'*) dimension:

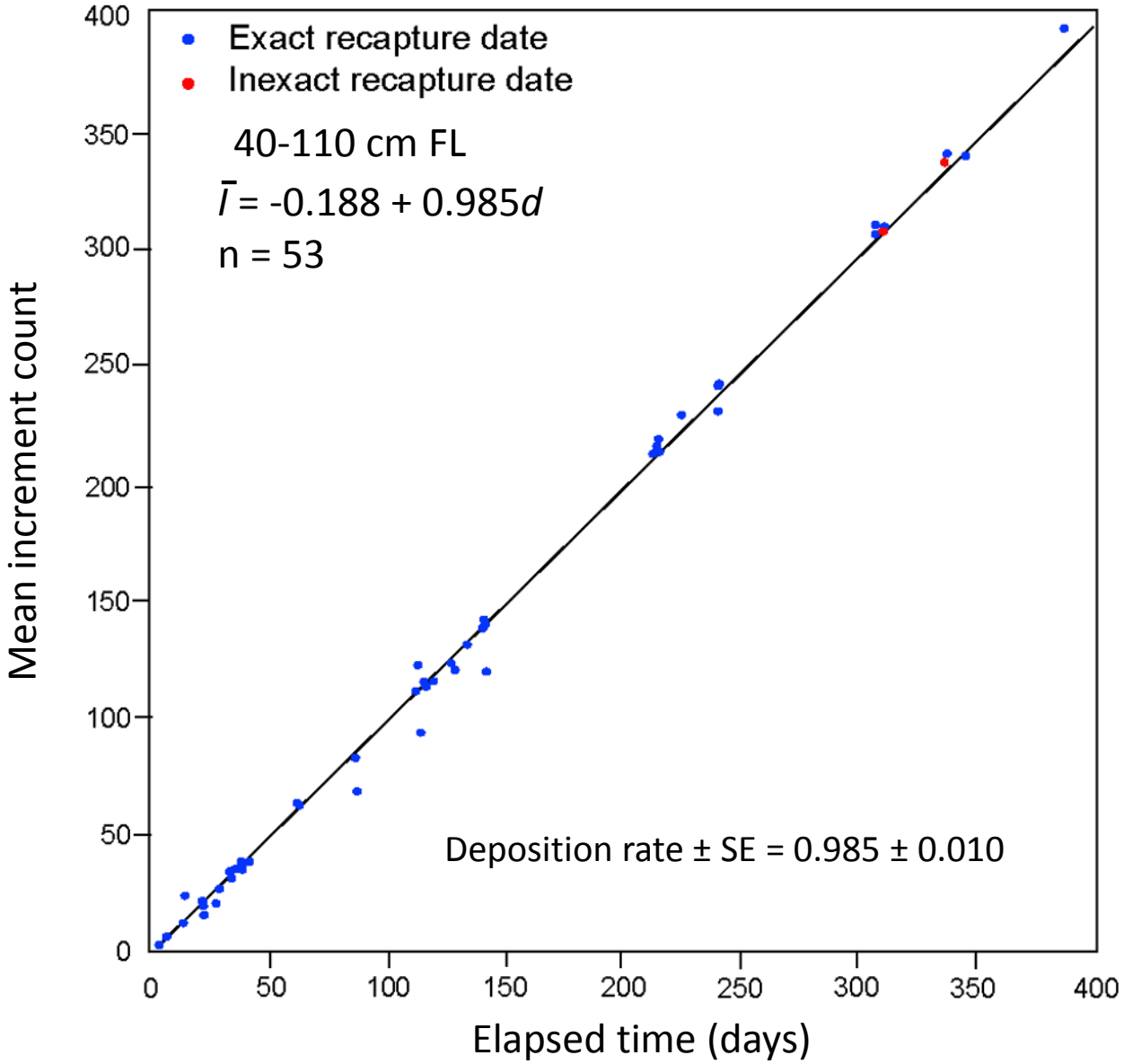
$$\ln(FL) = -2.289 + 1.433 \ln(P'), \text{ n= 212,}$$

Final and initial otolith measurements (to and from the OTC mark) substituted into the equation and the difference between the transformed FLs yields an estimate of the change in *FL* ($\triangle FL$) over time.

Growth rate for OTC-injected yellowfin is thus described by the weighted (INV of VAR of $\triangle FL$) linear regression:

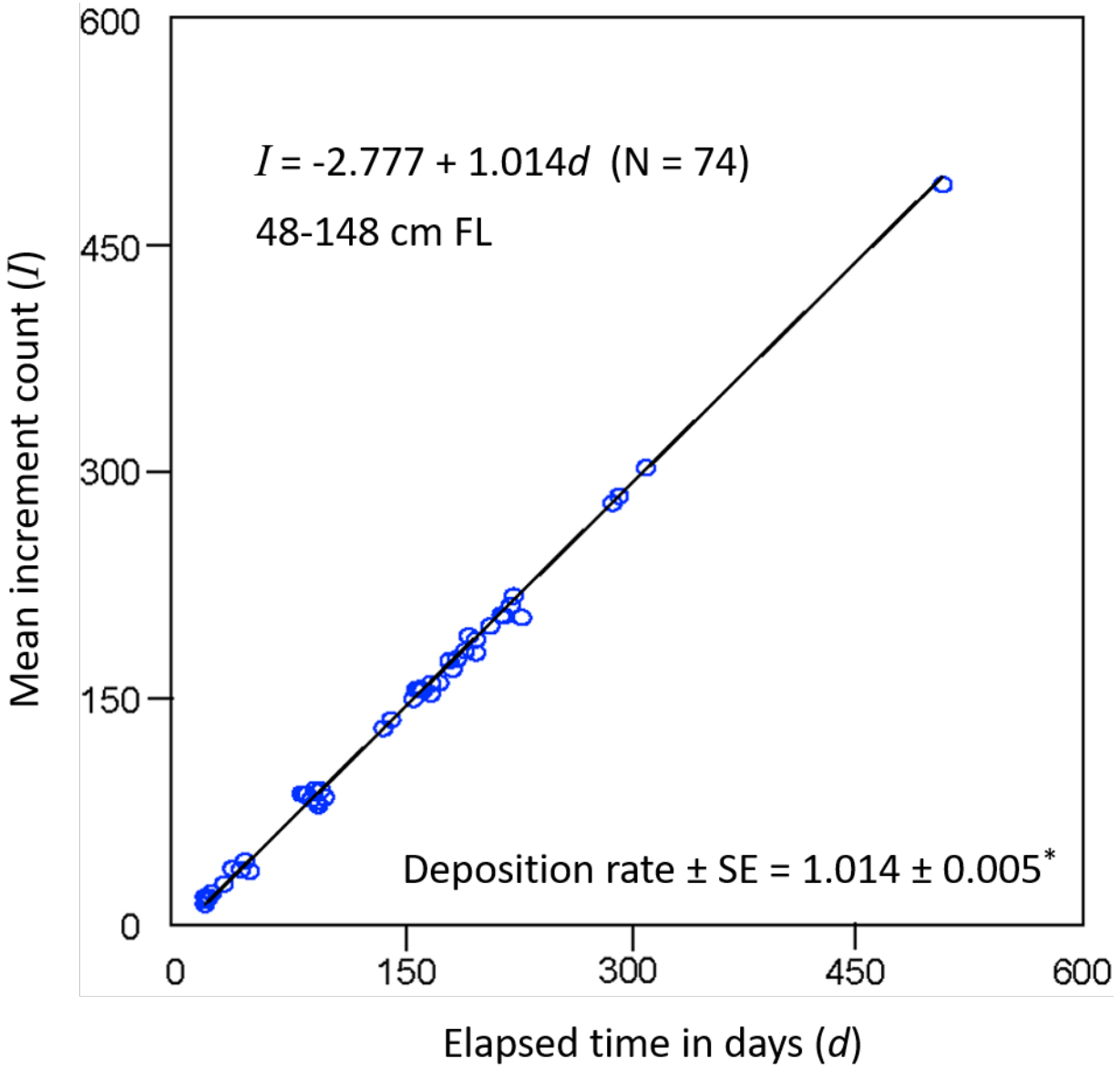
$$\triangle FL = -1.877 + 1.023\ (\triangle t), \quad (b \pm \text{SE} = 1.02 \text{ mm/d} \pm 0.79)$$

Relationship between mean increment counts and elapsed time in the sagittae of OTC-injected yellowfin recovered from the 1976 tagging experiment



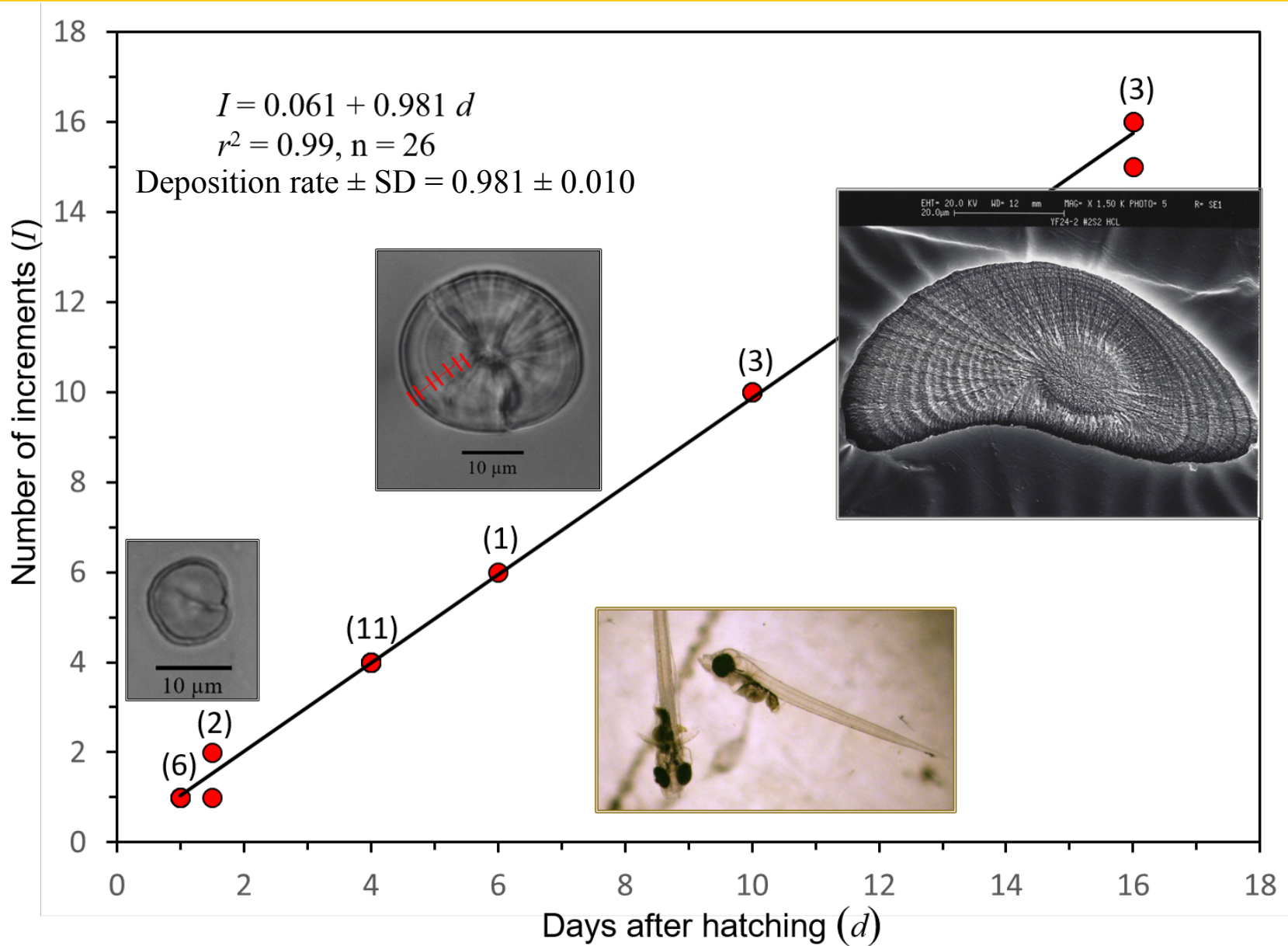
(Wild and Foreman, 1980)

Relationship between mean increment counts and elapsed time in the sagittae of OTC-injected yellowfin recovered from the 1980-1981 tagging experiments



(Wild et al., 1995)

Increment deposition rate in larval yellowfin tuna (3-7 mm SL) otoliths in the western Pacific Ocean (JASFA, IATTC ELH group)



(Wexler, et al. 2001)

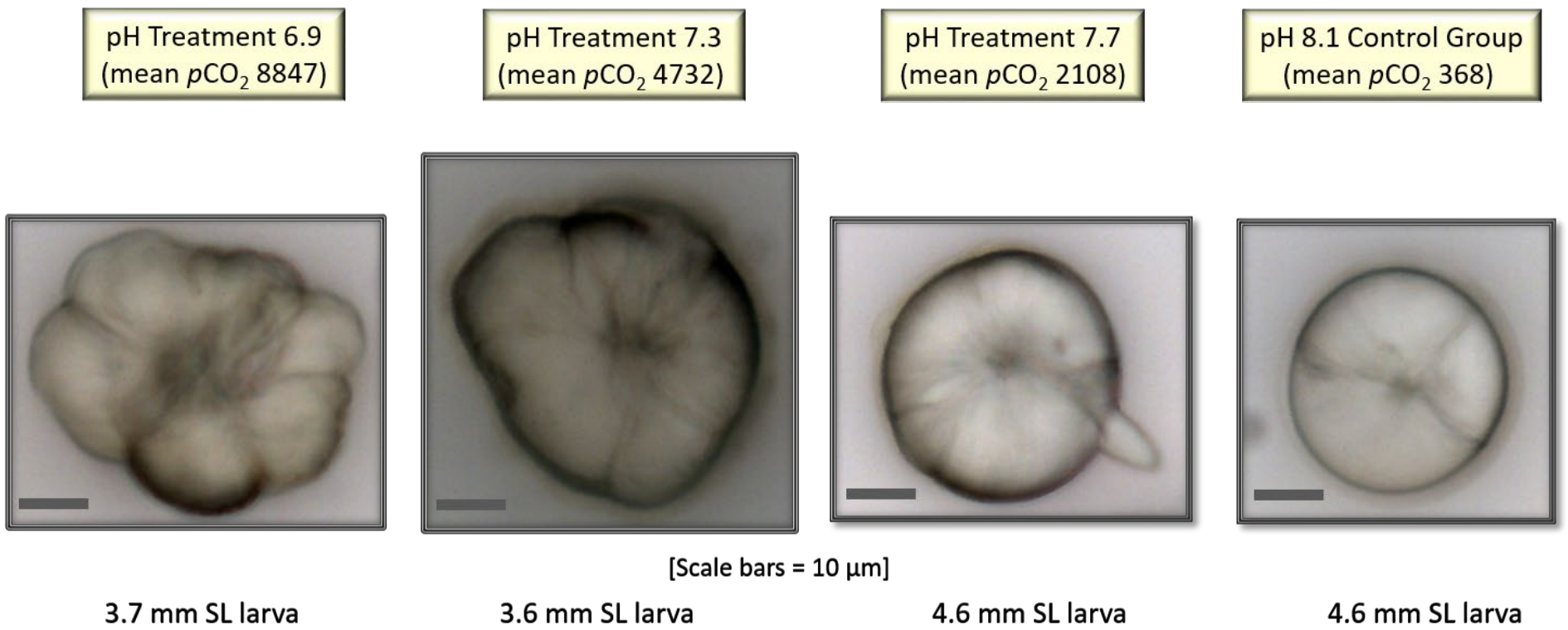
Daily increment validation studies for yellowfin tuna

OTC tagging/ recapture years	Length range	Range of days at liberty $\triangle t$	Ocean	Number of yellowfin	Relationship between the change in mean increments and elapsed time $\triangle t$	Reference
1976-1981	40-148 cm FL	3-515	EPO	127	1:1	Wild and Foreman, 1980; Wild et al., 1995
1979-1983	?	32-132	SE Atlantic	5	1:1	IATTC Annual Report, 1987
1987[1]	25-40 cm FL	21-39	Central Pacific	12	1:1	Yamanaka, 1989
1992[1]	3-7 mm SL	1-16	Western Pacific	26	1:1	Wexler et al., 2001
1992	35-91 cm FL	21-175	South and SW Pacific	3	1:1[2]	Lehodey and Leroy, 1999; IATTC Annual Reports 1992-1994

[1] Laboratory validation

[2] Final confirmation needed with transverse section and SEM for largest fish

Ocean acidification effects on otolith composition in 9-day old yellowfin larvae



Experiment described in Bromhead et al. (2015)

Summary

Results of the early mark-recapture experiments of 1976 and 1980-81 provide significant information supporting the validation of daily increments in the otoliths of 40-148 cm FL yellowfin tuna,

And support the techniques used to adequately age and determine growth rates used for stock assessments of yellowfin tuna in the EPO

Methods used in these studies may apply to yellowfin in other oceans but uncertainties exist with changes in different ocean chemistries and the physical structure (calcium carbonate accretion) of the otoliths

Questions