



ADF&G

Age Determination Unit

Biological Pattern Interpretation – Aging – of Long-lived Species

*Dedicated to Ladd Macaulay, for his
influence on thermal marking in Alaska, and
his support of my thermal marking work.*

Age Determination Unit

- Statewide age reading lab (1991-2011)
- Marine fishes and invertebrates
- Commercial and survey harvests
- ~10000 age data per year
- Conduct age-related work
- Contemporary Archive (1991-2011): 43spp groundfish, 6spp inverts
 - >>15 additional spp in other archives

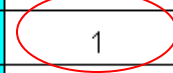
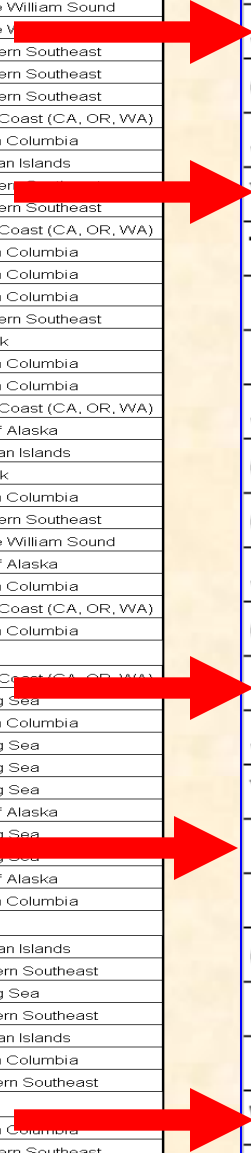
Long-lived vs short-lived?



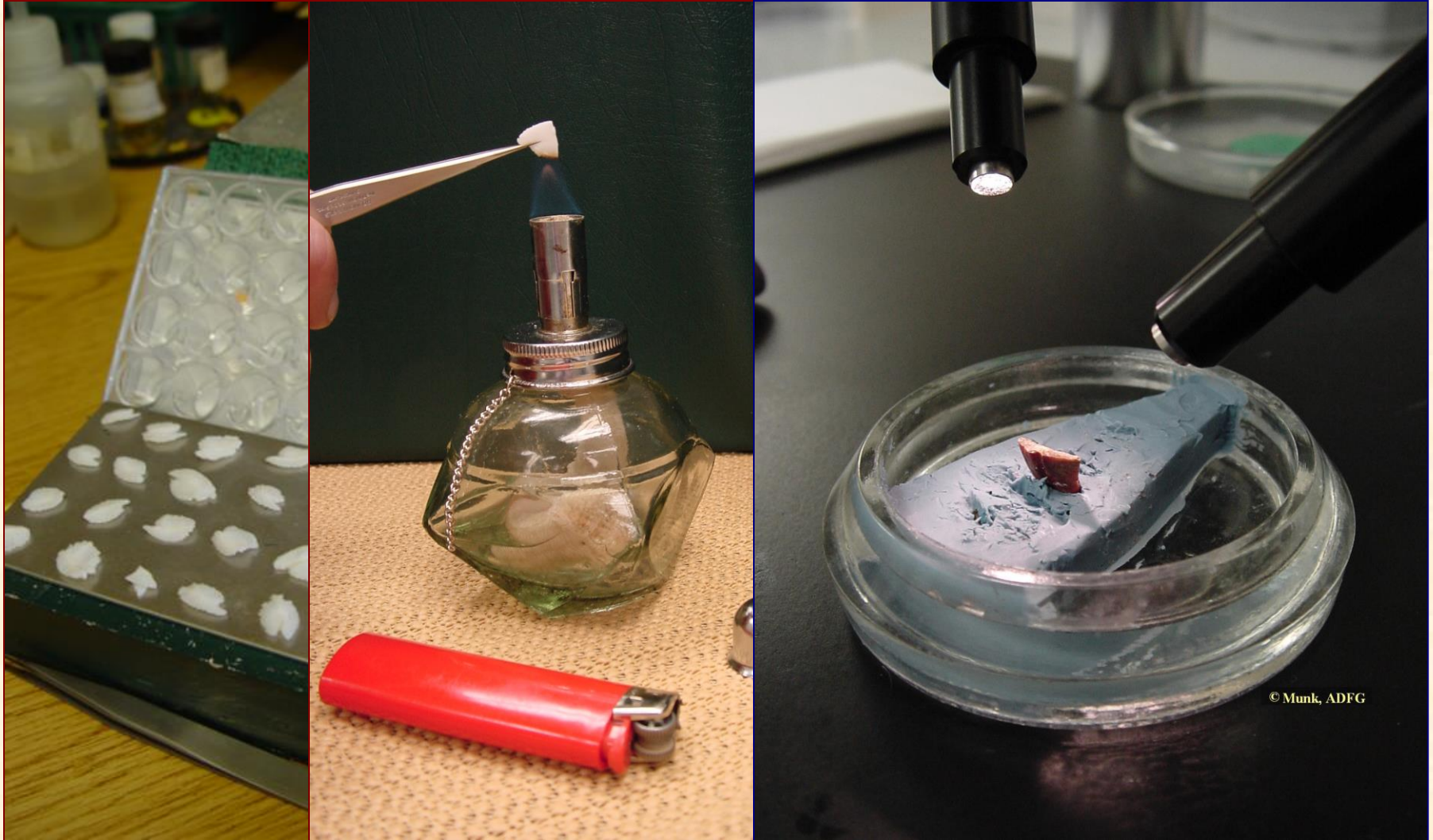
Table 1. Maximum ages of some groundfish and invertebrates in the Pacific Ocean.

COMMON NAME	MAX AGE	Sample Size Examined	CAPTURE LOCATION
ROCKFISHES			
Rougheye rockfish	205	>10000	Southern Southeast
Shortraker rockfish	160	>10000	Prince William Sound
Shortspine thornyhead	133	>1000	Prince William Sound
Yelloweye rockfish	121	>10000	Southern Southeast
Tiger rockfish	116	>1000	Southern Southeast
Redbanded rockfish	106	>1000	Southern Southeast
Darkblotched rockfish	105	>1000	West Coast (CA, OR, WA)
Yellowmouth rockfish	99	>4000	British Columbia
Pacific ocean perch	98	>10000	Aleutian Islands
Quillback rockfish	90	>10000	Southern Southeast
Rosethorn rockfish	87	>100	Southern Southeast
Blackgill rockfish	87	>1000	West Coast (CA, OR, WA)
Splitnose rockfish	86	>200	British Columbia
Canary rockfish	84	>5000	British Columbia
Silvergrey rockfish	81	>10000	British Columbia
China rockfish	78	>1000	Southern Southeast
Dusky rockfish	67	>10000	Kodiak
Yellowtail rockfish	64	>10000	British Columbia
Widow rockfish	60	>3000	British Columbia
Vermillion rockfish	60	1	West Coast (CA, OR, WA)
Sharpchin rockfish	58	>500	Gulf of Alaska
Northern rockfish	57	>1000	Aleutian Islands
Black rockfish	56	>10000	Kodiak
Redstripe rockfish	55	>2000	British Columbia
Greenstriped rockfish	54	1	Southern Southeast
Copper rockfish	50	>200	Prince William Sound
Bocaccio rockfish	46	>100	Gulf of Alaska
Harlequin rockfish	43	>300	British Columbia
Blue rockfish	30	>200	West Coast (CA, OR, WA)
Pygmy rockfish	26	>100	British Columbia
FLATFISHES			
Dover sole	60	>1000	West Coast (CA, OR, WA)
Pacific halibut	55	>10000	Bering Sea
Petrale sole	35	>6000	British Columbia
Yellowfin sole	34	>200	Bering Sea
Kamchatka flounder	33	>120	Bering Sea
Alaska plaice	31	>500	Bering Sea
Rex sole	27	>200	Gulf of Alaska
Flathead sole	27	>1000	Bering Sea
Rock sole	26	>200	Bering Sea
Arrowtooth flounder	23	>1000	Gulf of Alaska
English Sole	22	>1000	British Columbia
ROUNDFISHES or SHARK			
Sablefish	94	>10000	Aleutian Islands
Lingcod	36	>10000	Northern Southeast
Walleye pollock	33	>10000	Bering Sea
Kelp greenling	18	10	Northern Southeast
Atka mackerel	15	>5000	Aleutian Islands
Spiny dogfish (shark)	66	>1000	British Columbia
Wolf Eel	28	1	Northern Southeast
INVERTEBRATES			
Geoduck clam	146	>1000	British Columbia
Green urchin	16	>300	Southern Southeast
Red urchin	35	>300	Southern Southeast

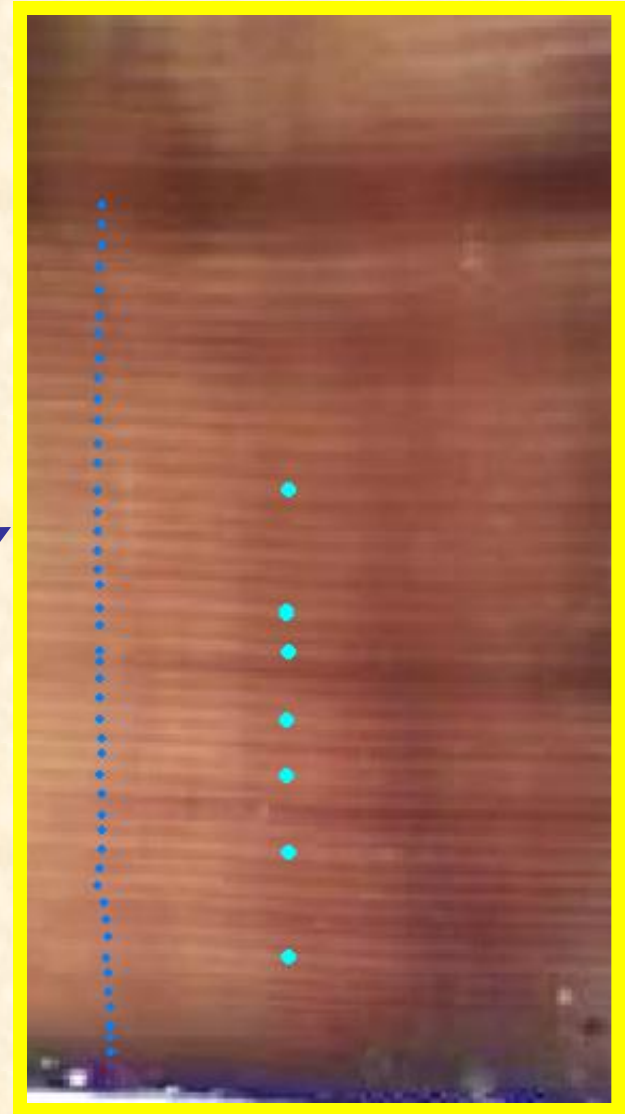
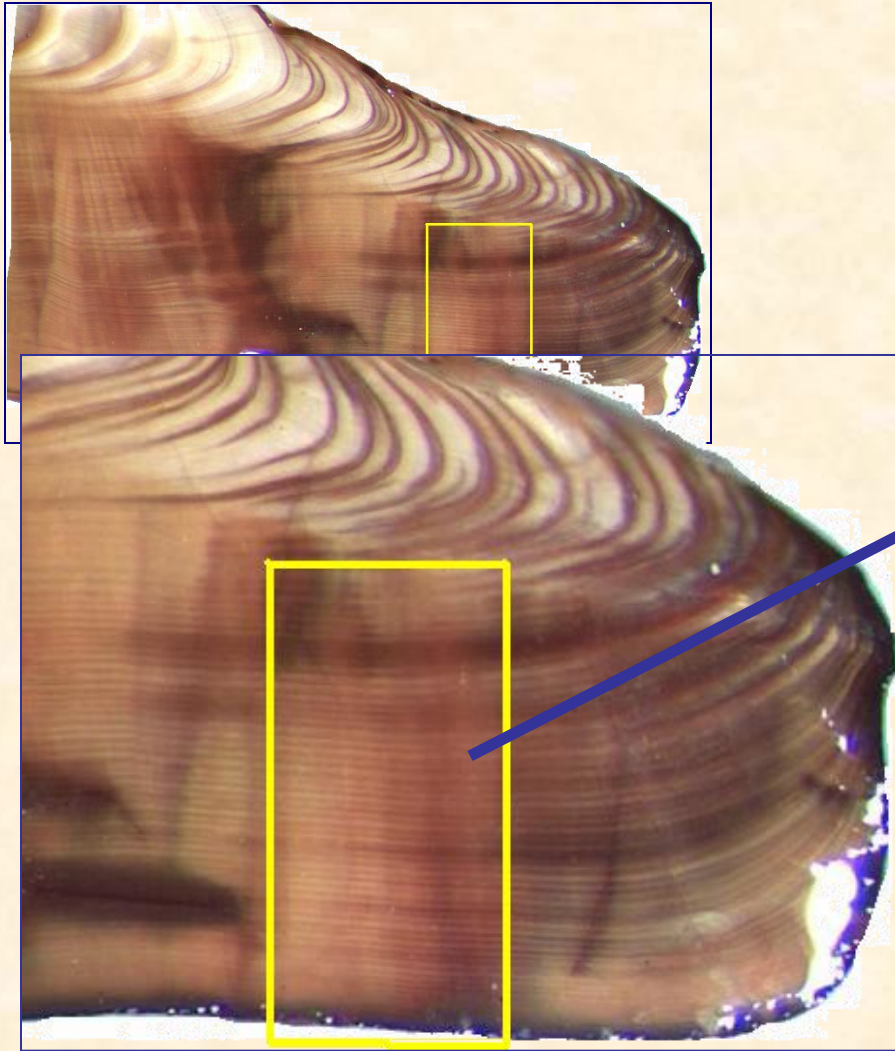
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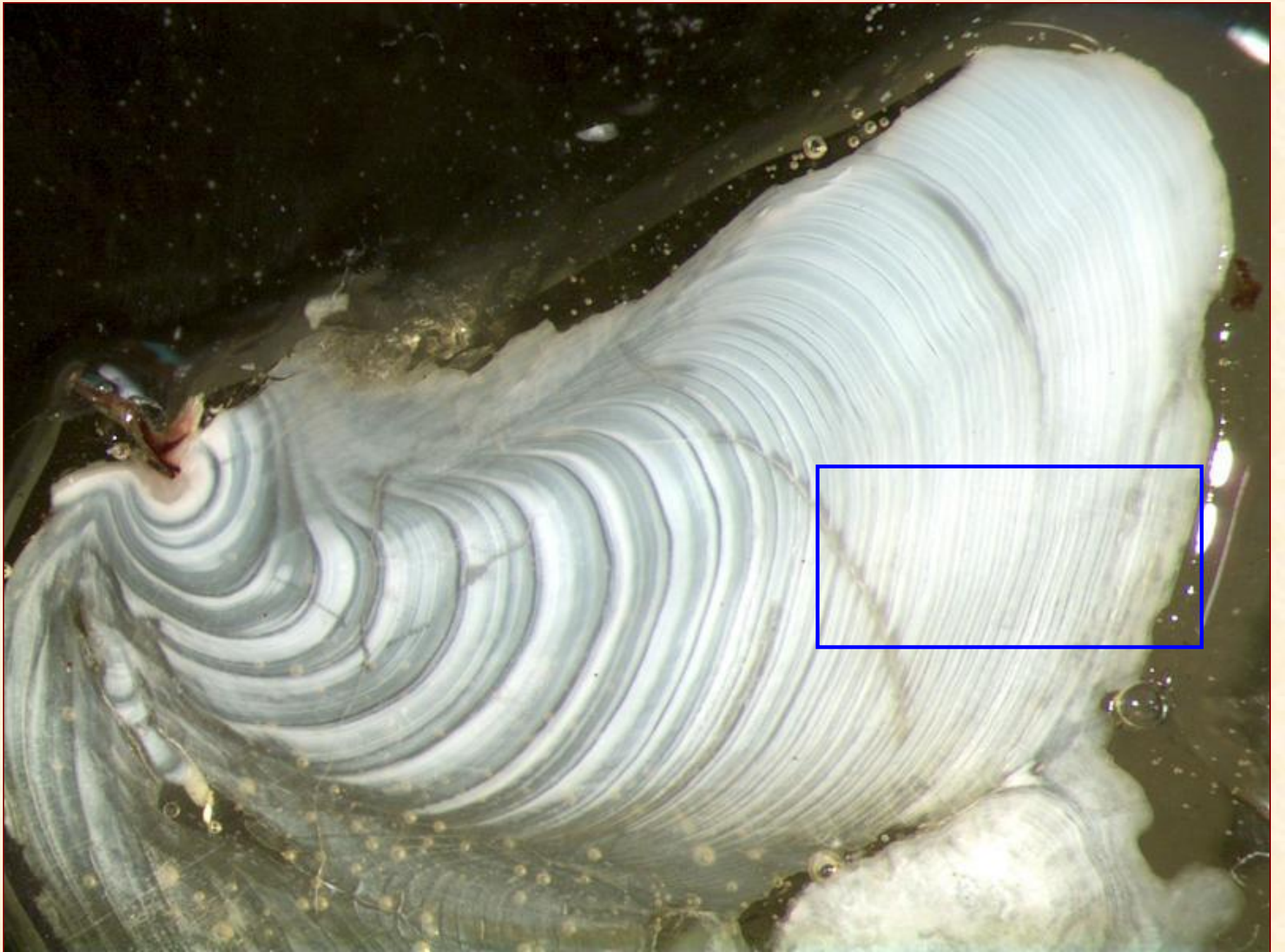


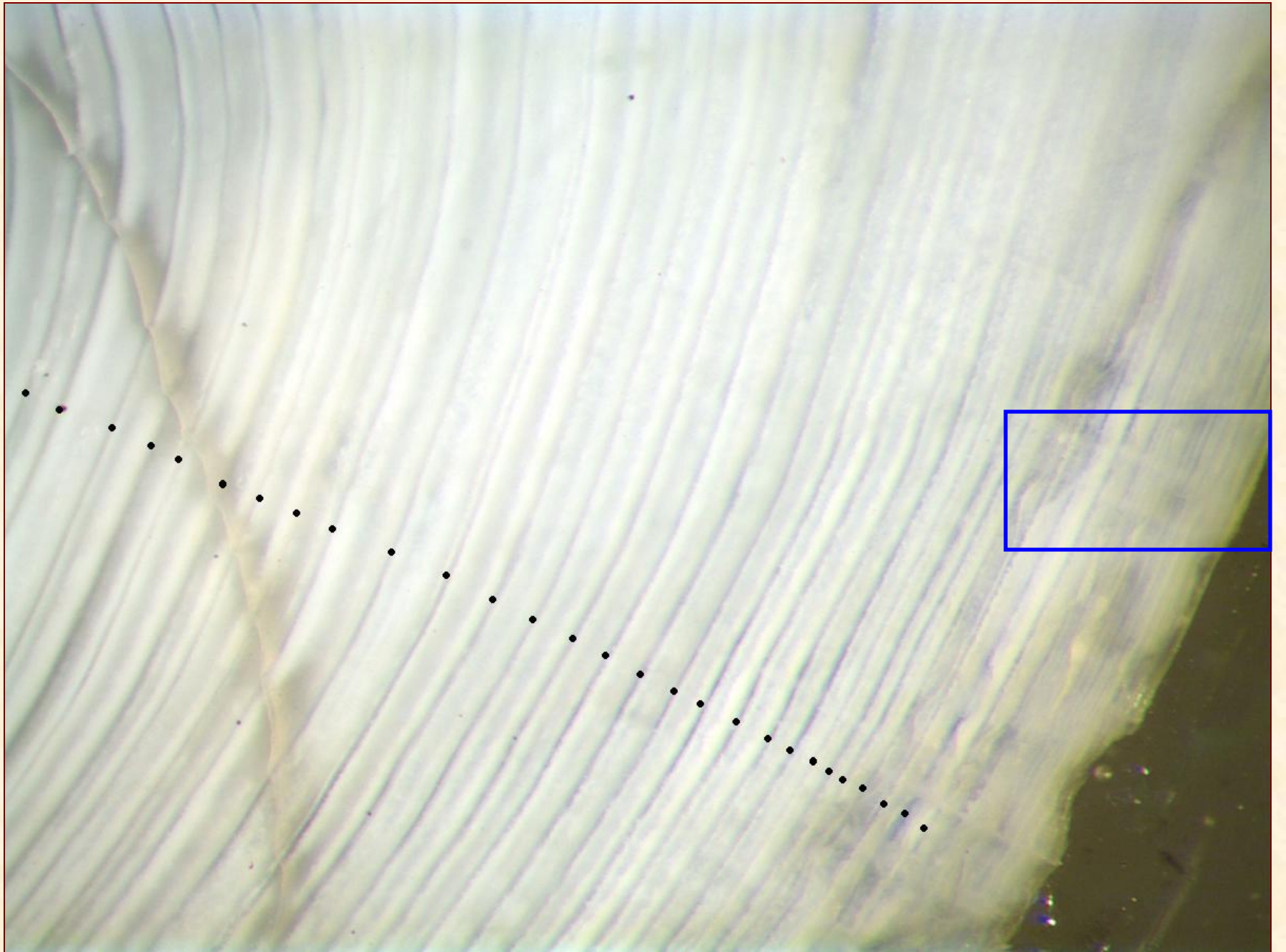
Examining long-lived growth patterns

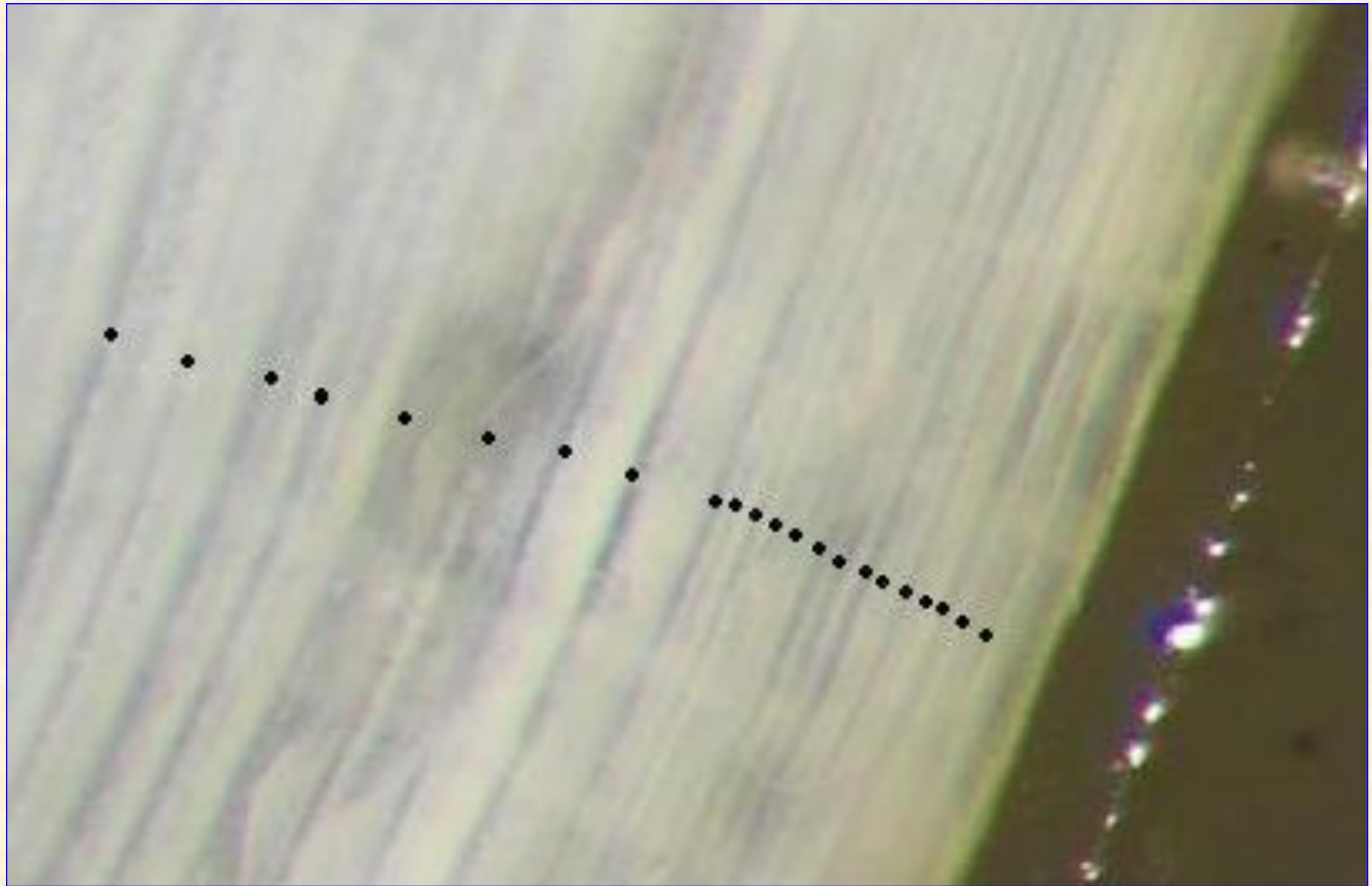


Yelloweye Rockfish

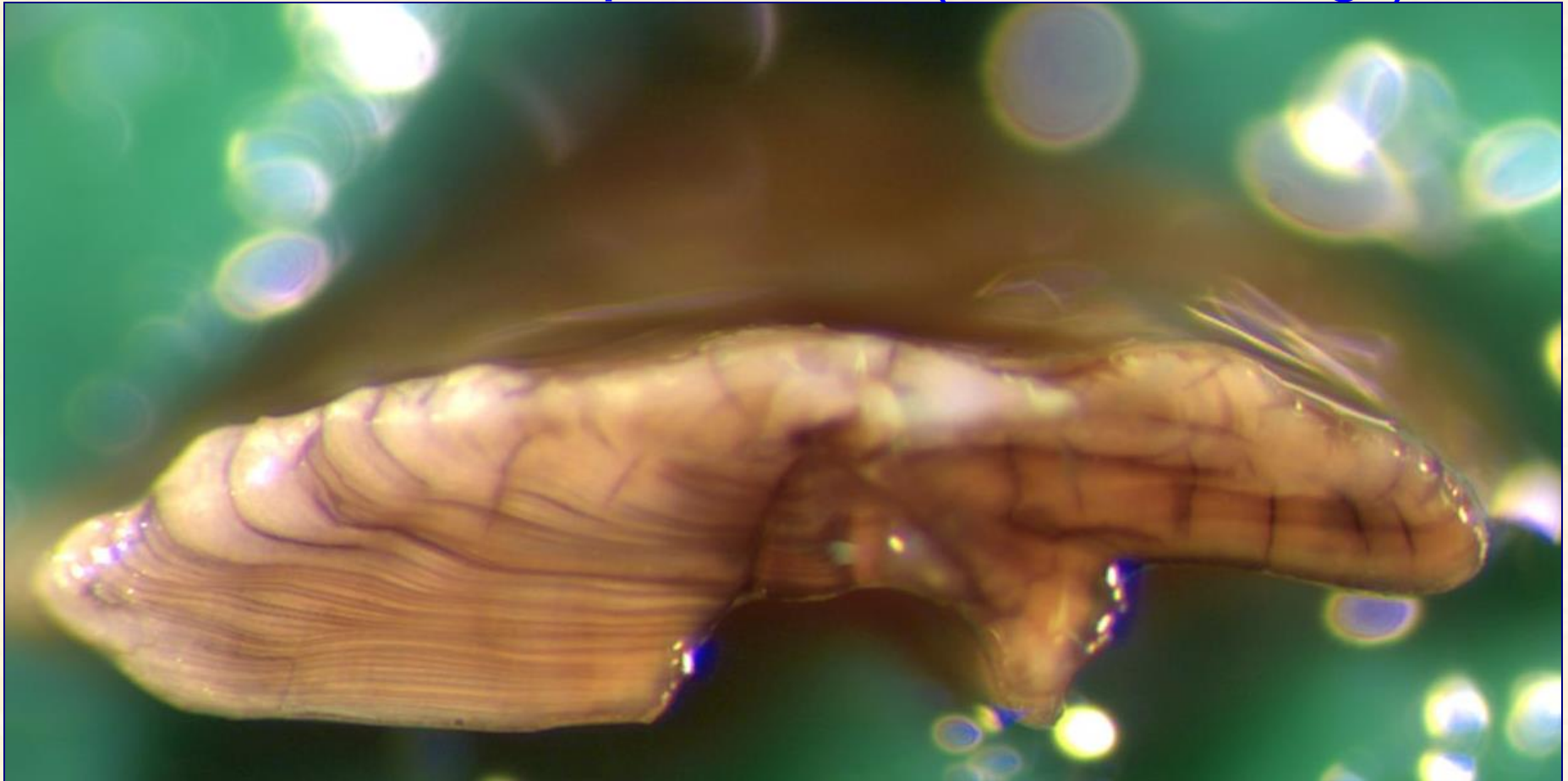


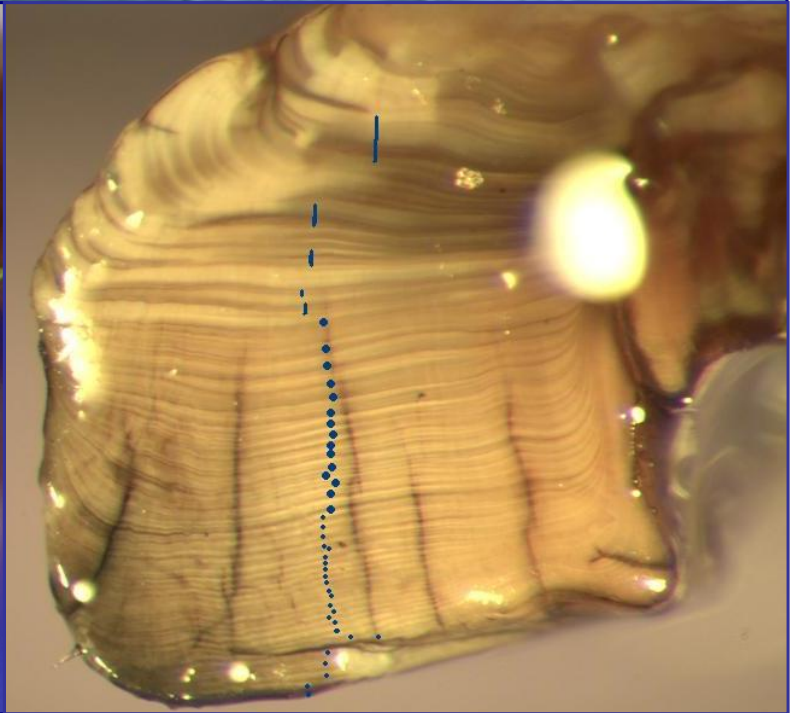
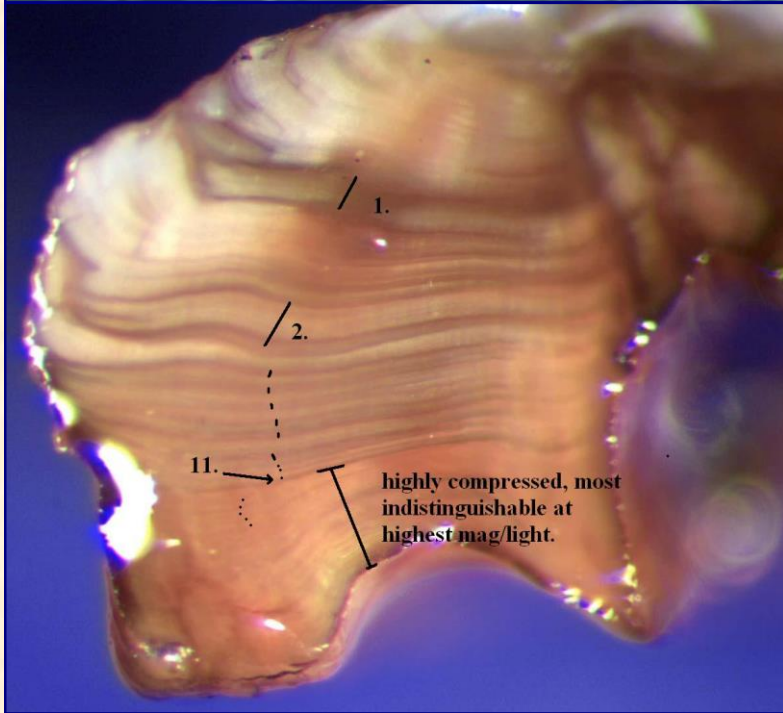




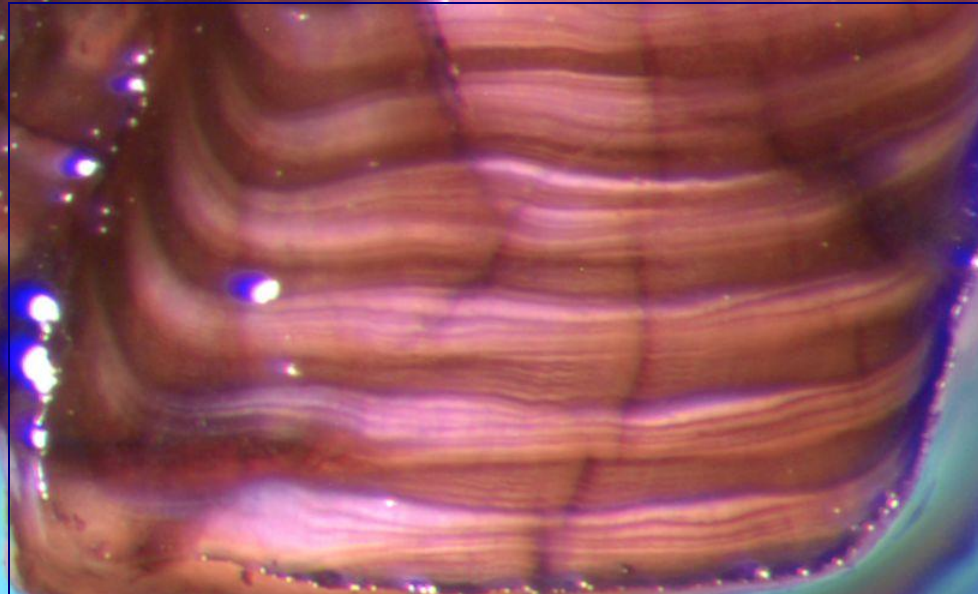


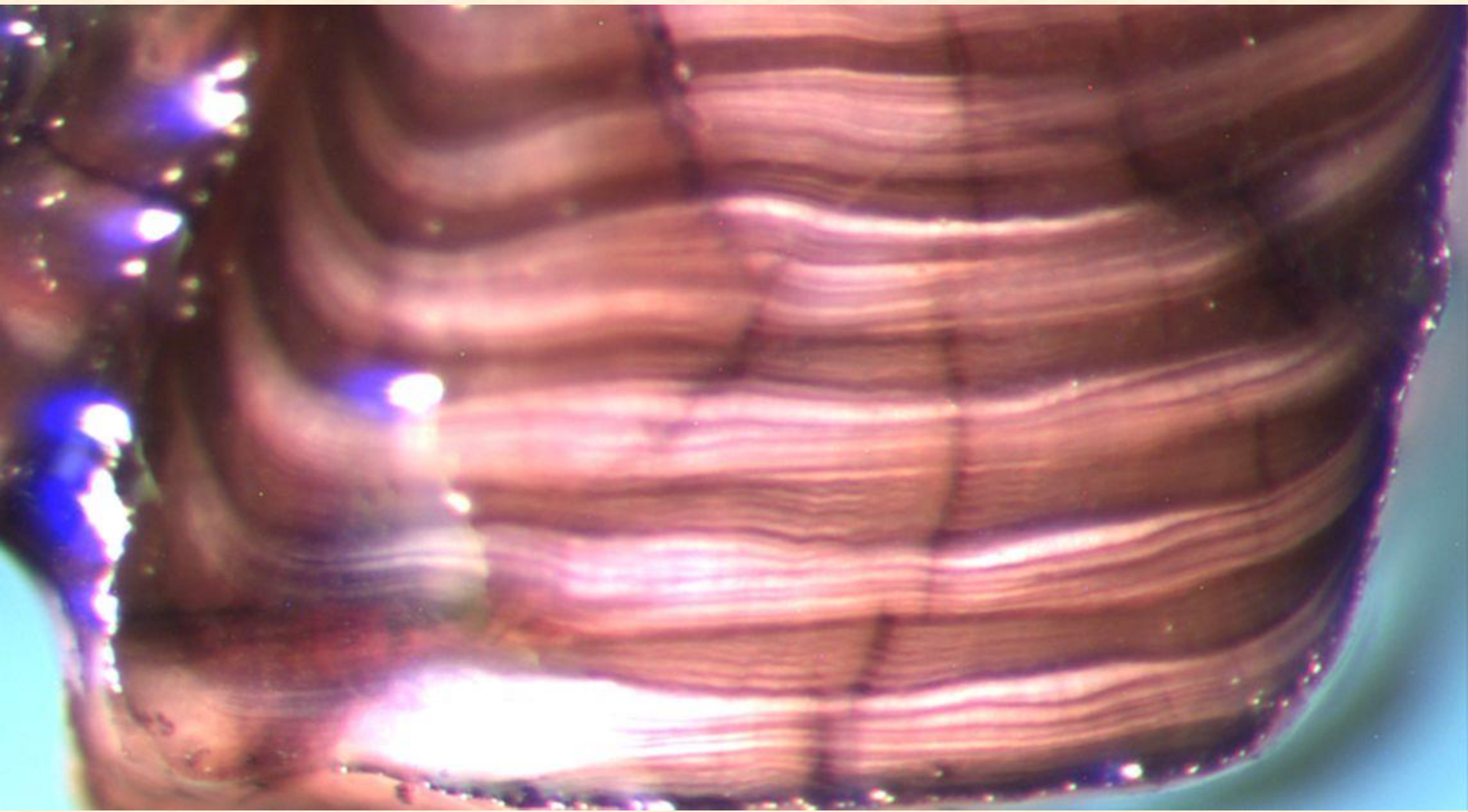
Pattern “Interpretation” (not “counting”)





Pop Quiz!





“Otolith Accretion Model”

as basis for growth pattern interpretation . . .

- Otolith accretion is additive and reflects both environmental and genetic influences on the animal.
- Senescent growth in animals
- Calcium metabolism



not smooth, wrinkly



smooth, contour - wavy



not smooth, wavy



smooth, general

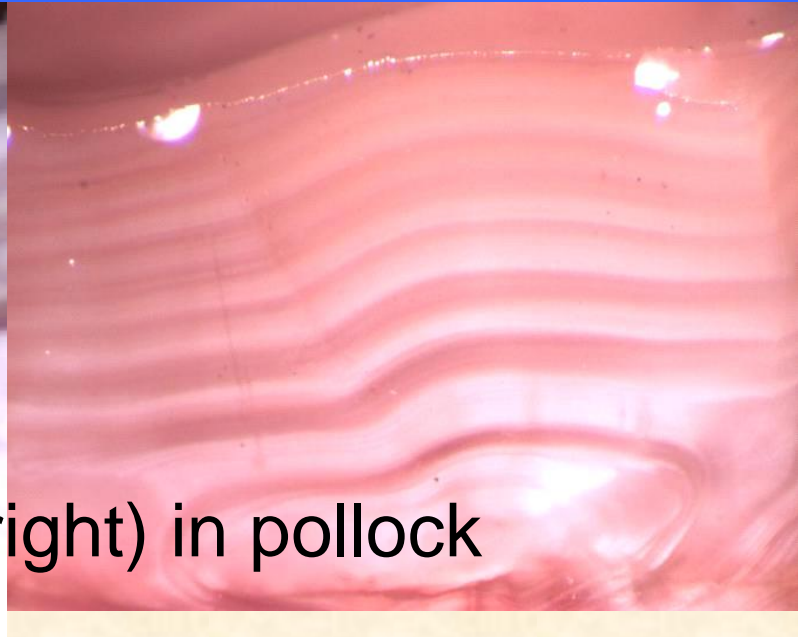
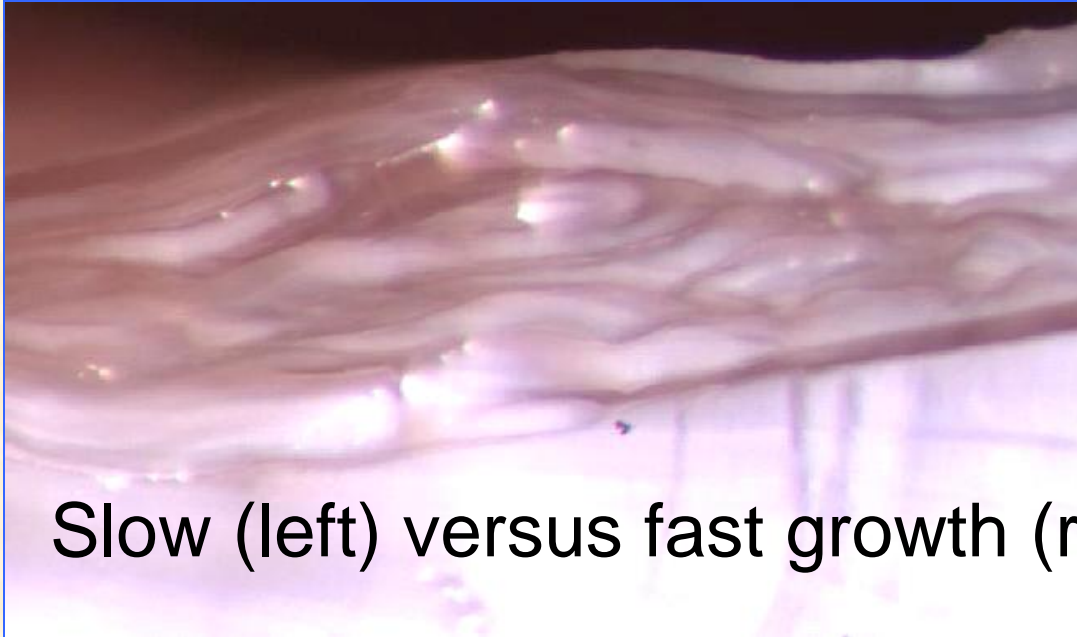
The image shows three white, shell-like structures arranged vertically. The top structure has a very distinct, regular pattern of small, rounded protrusions and indentations. The middle structure has a similar pattern but the protrusions are more rounded and the indentations are less pronounced. The bottom structure has a very irregular, almost smooth surface with some small protrusions and indentations, but they are much less distinct than in the other two structures. An arrow points from the text 'crenulation' to the top structure. Another arrow points from the text 'Clean "hills and vallies"' to the top structure. The text 'Mediated hills and vallies' is positioned above the middle structure with an arrow pointing to it. The text 'Hills and vallies overgrown' is positioned above the bottom structure.

crenulation

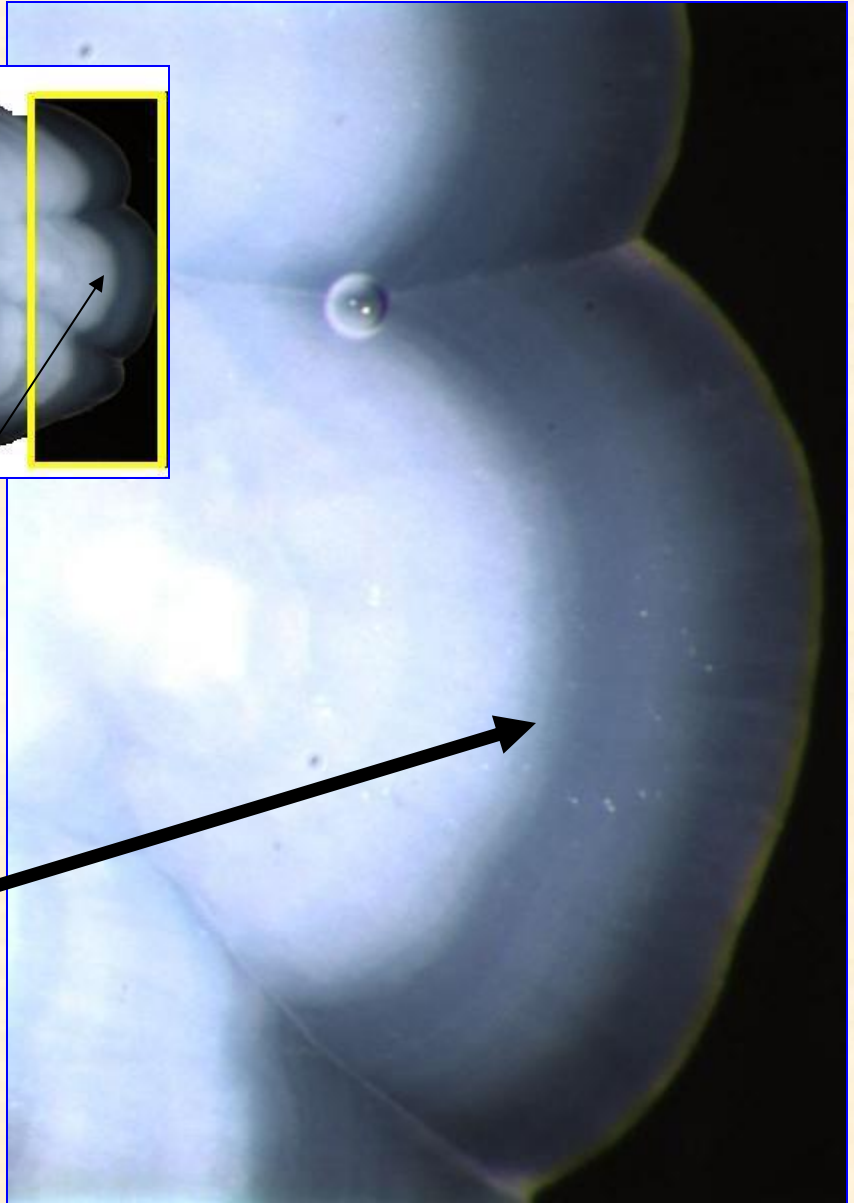
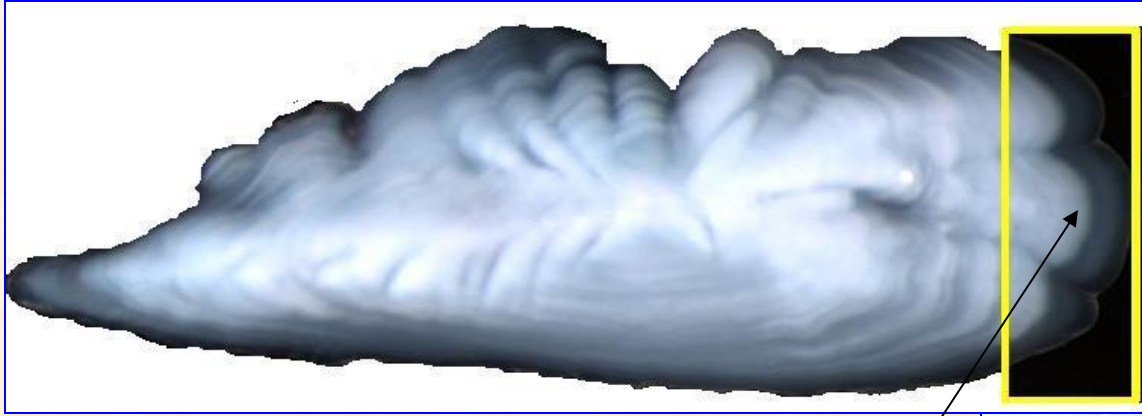
Clean "hills and vallies"

Mediated hills and vallies

Hills and vallies overgrown



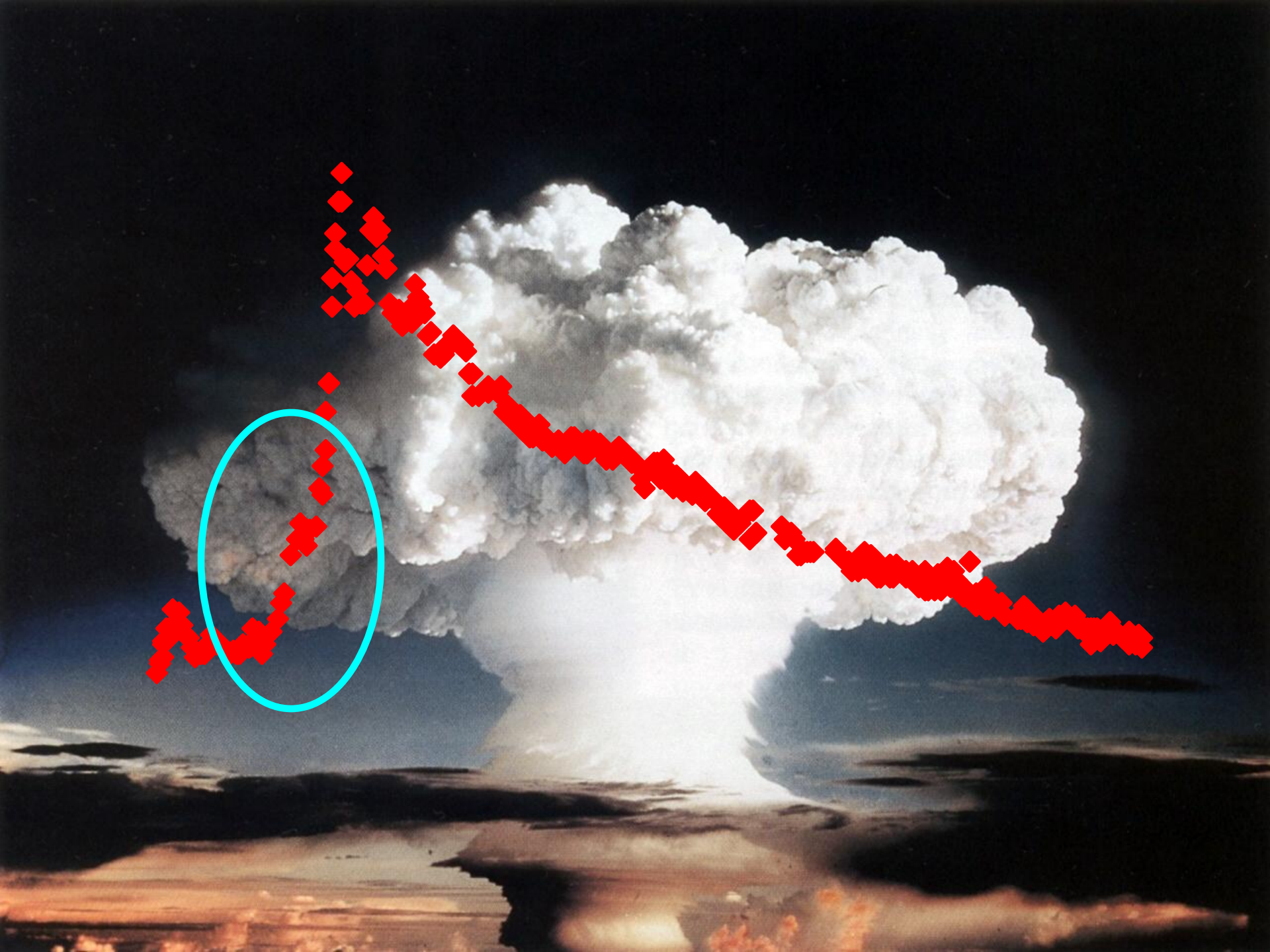
Slow (left) versus fast growth (right) in pollock



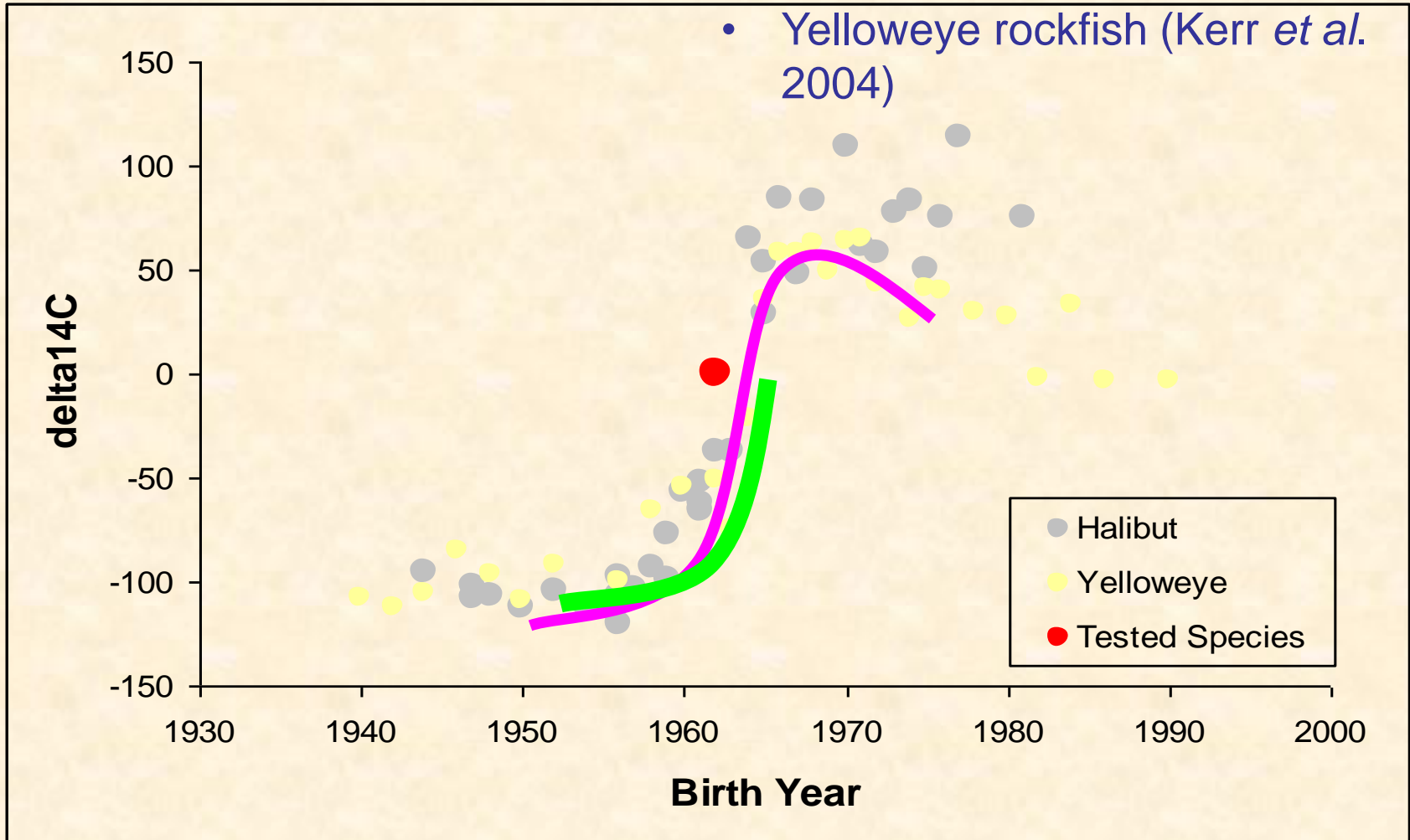
Growth/accretion
slows, annuli are
more closely
spaced, "dense"

Age validation methods

- Cross-dating
- Elemental and Thermal Marking (strontium, rare earth elements)
- Isotopic measurement (lead-radium radiometric; oxygen isotope)
- Marginal increment analysis
- Chemical Staining (alizarin, oxytetracycline, calcein, fluorescein)
- Known-age marking
- **Bomb Radiocarbon Chronometer**

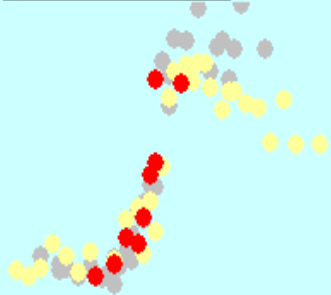


- Halibut (Piner and Wischniowski 2004)
- Yelloweye rockfish (Kerr *et al.* 2004)

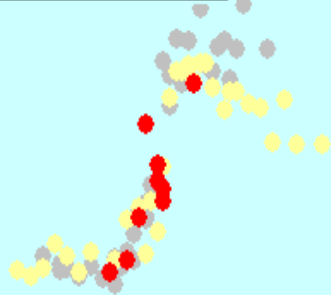


Validated

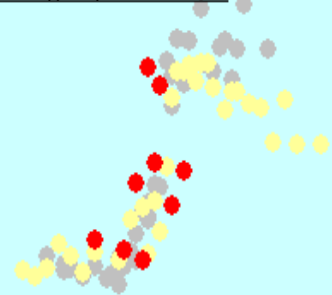
Silvergrey Rockfish



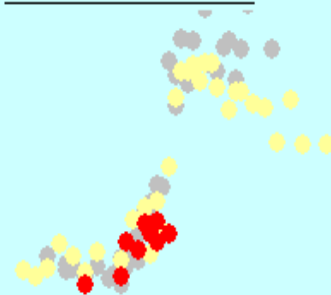
Shortraker Rockfish



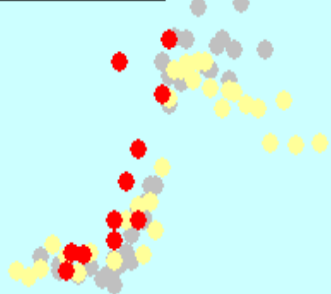
Rougheye Rockfish



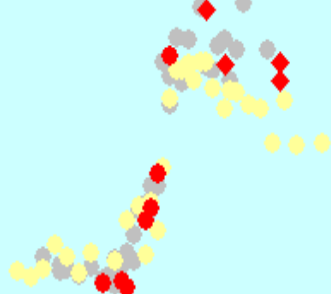
Redbanded Rockfish



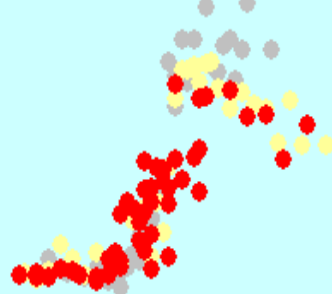
Tiger Rockfish



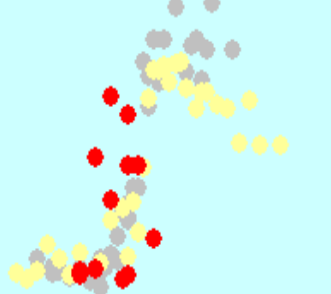
Dusky Dark Rockfish



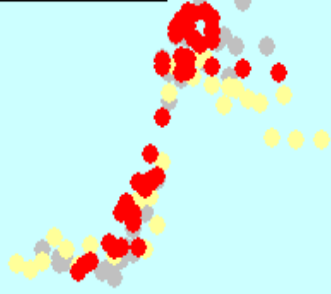
Thornyhead Rockfish



Sablefish

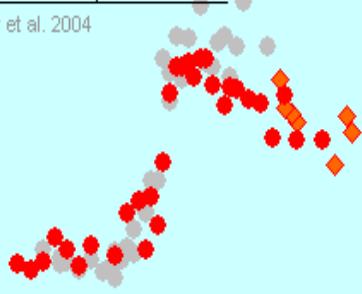


Black Rockfish



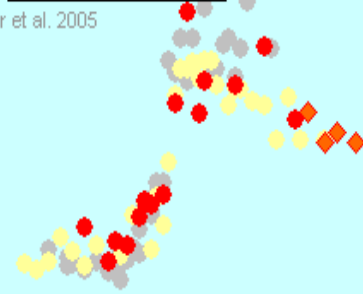
Yelloweye Rockfish

Kerr et al. 2004



Quillback Rockfish

Kerr et al. 2005

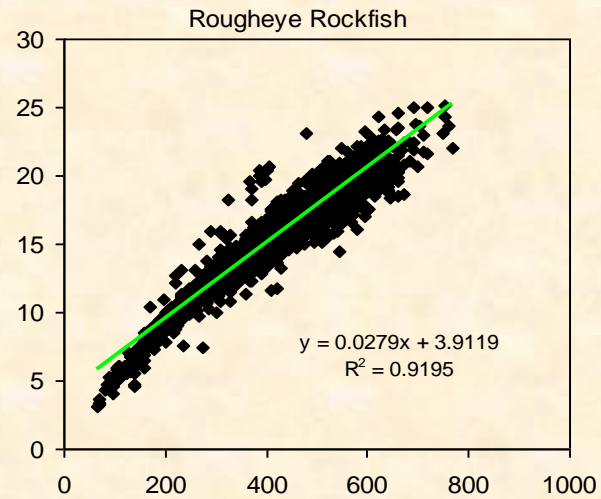
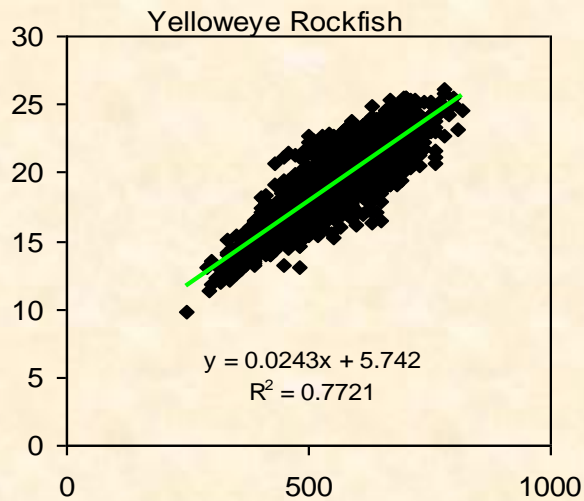
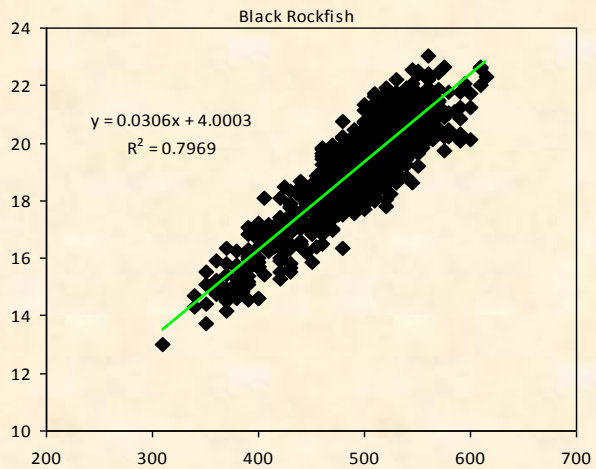
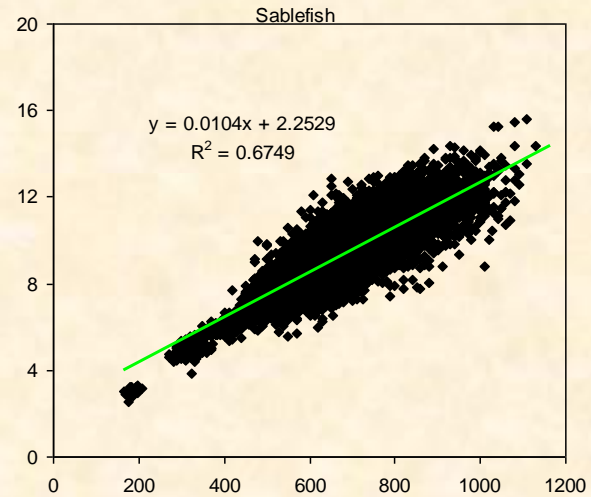
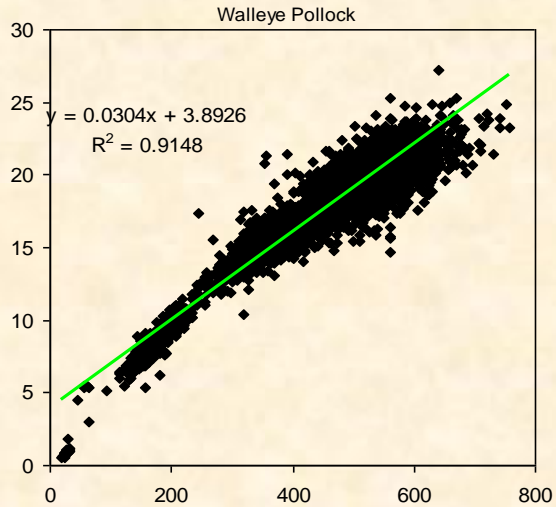
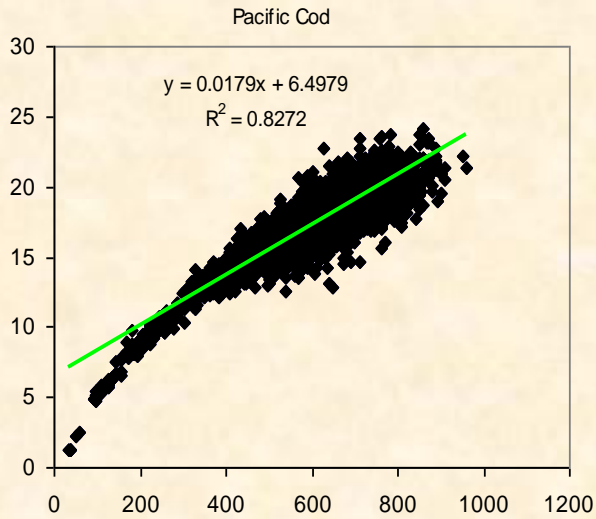


- Pacific halibut chronology, Piner and Wischniowski 2004
- Yelloweye Rockfish (SEA); Kerr et al. 2004
- Tested species

Validation/Corroboration

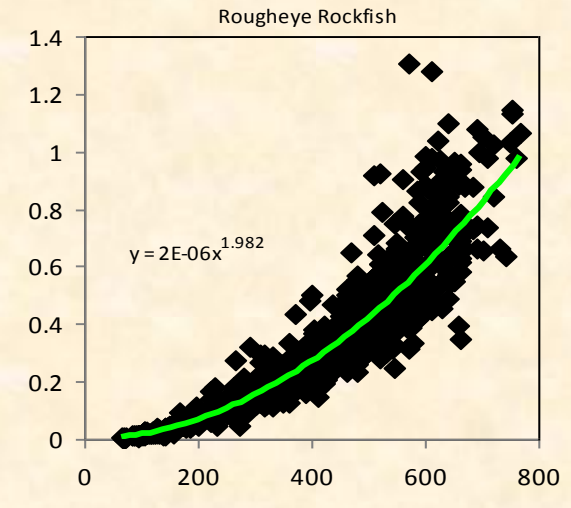
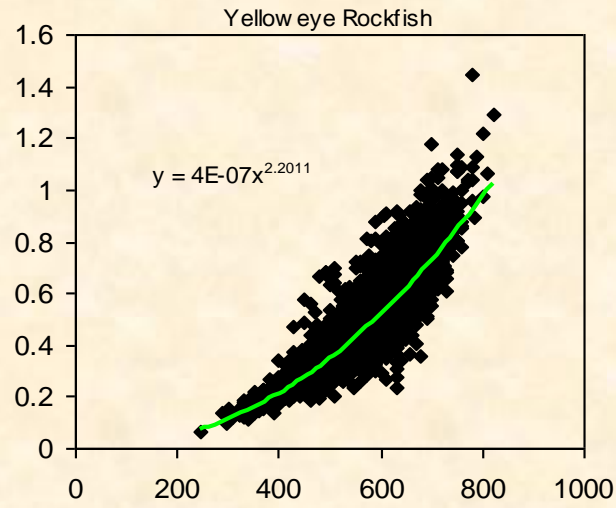
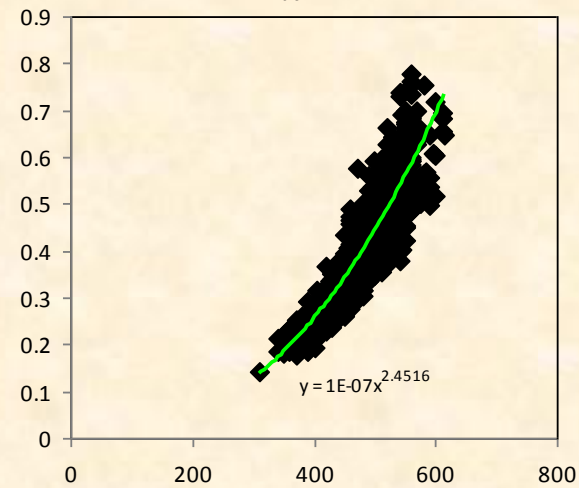
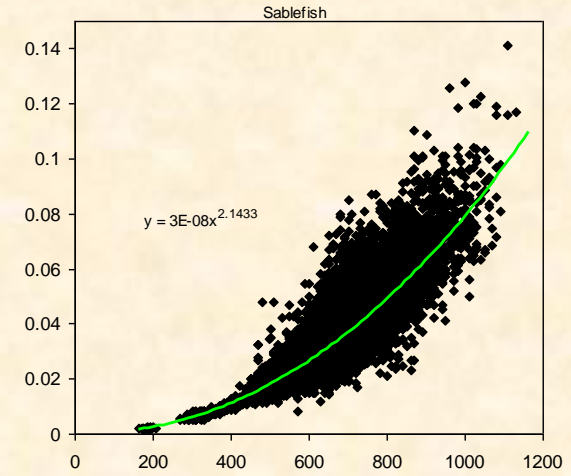
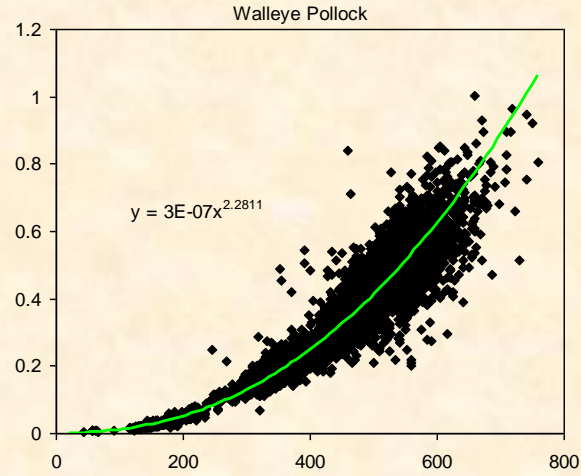
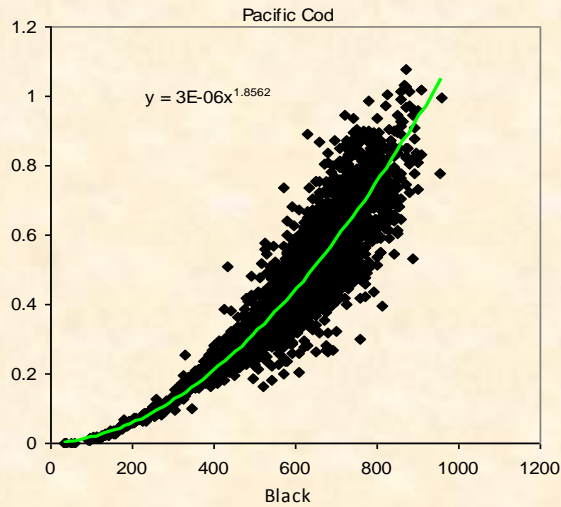
- **Age Structure Measurement**
- Known otolith accretion

Otolith Length mm



Somatic Length mm

Otolith Weight g

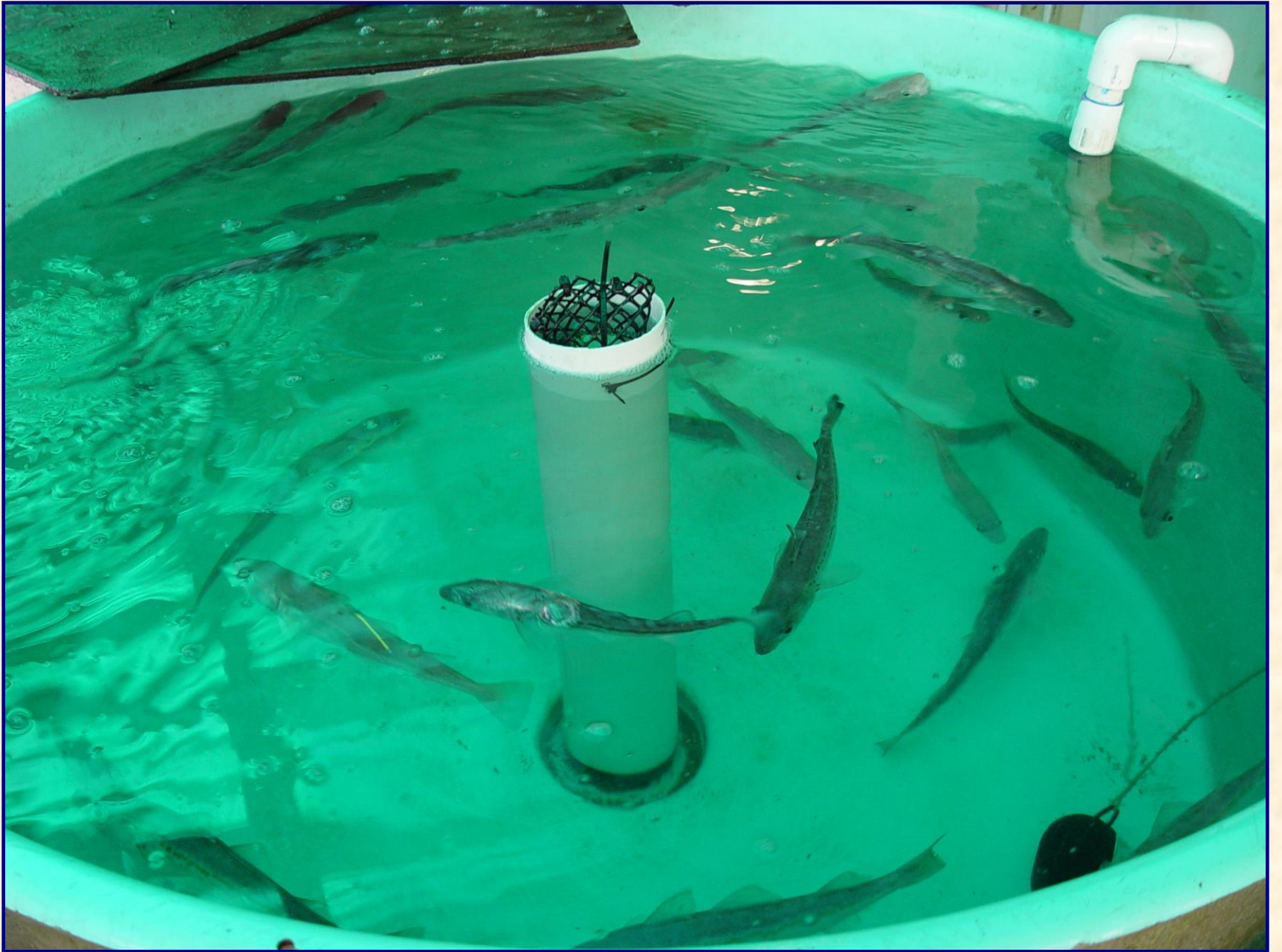


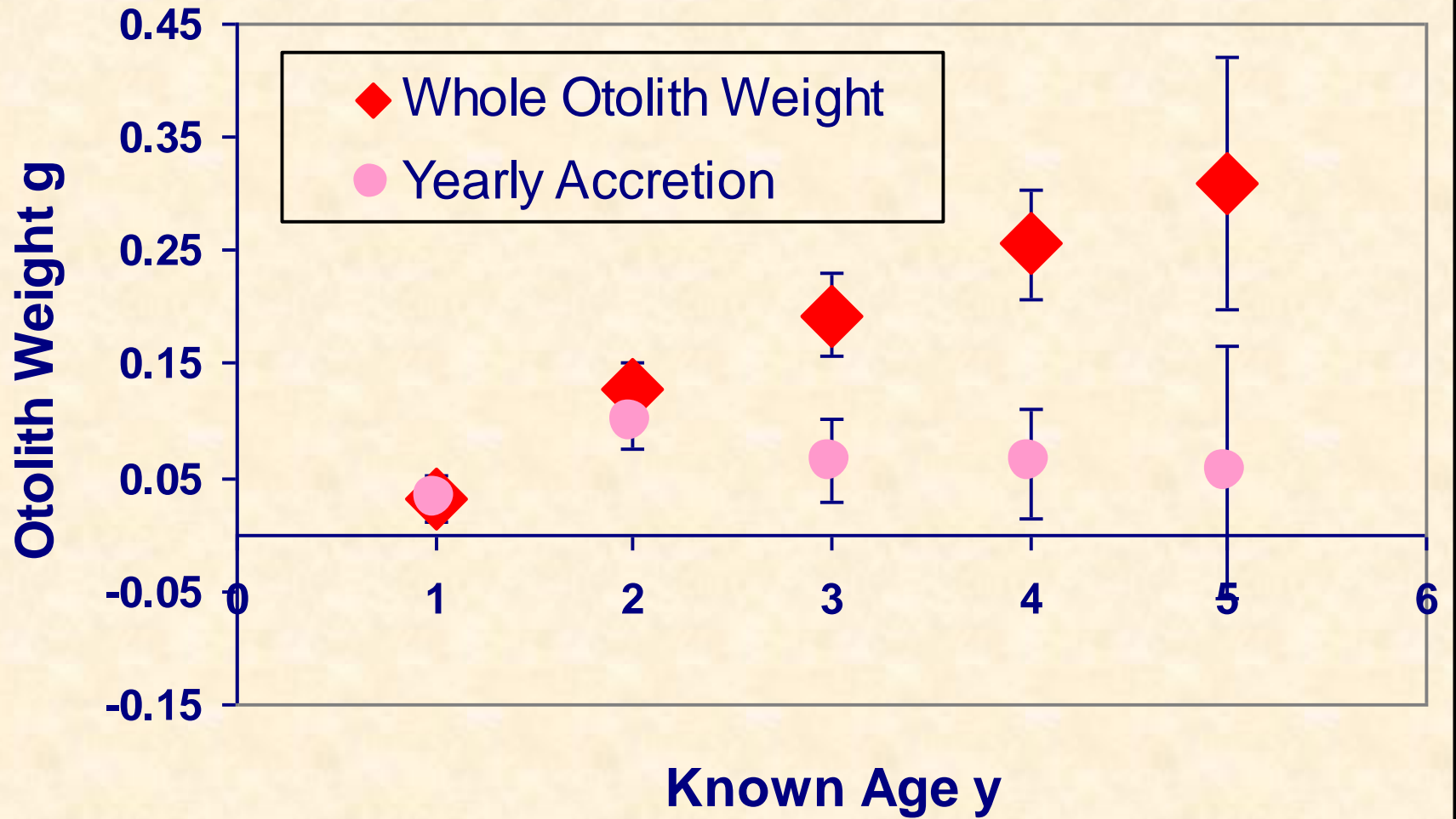
Somatic Length mm

Validation...Corroboration

- Age Structure Measurement
- **Known otolith accretion**









Questions?