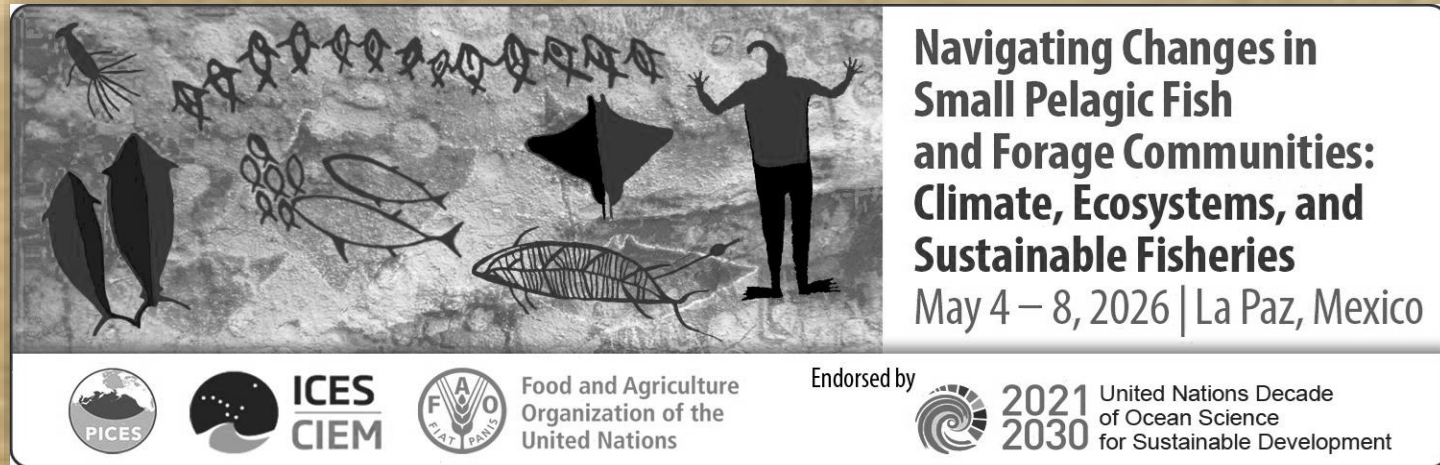






Linking Atlantic herring larval growth variability to recruitment strength in eastern Canada over the last four decades



Navigating Changes in Small Pelagic Fish and Forage Communities: Climate, Ecosystems, and Sustainable Fisheries
May 4 – 8, 2026 | La Paz, Mexico

Endorsed by  2021-2030 United Nations Decade of Ocean Science for Sustainable Development

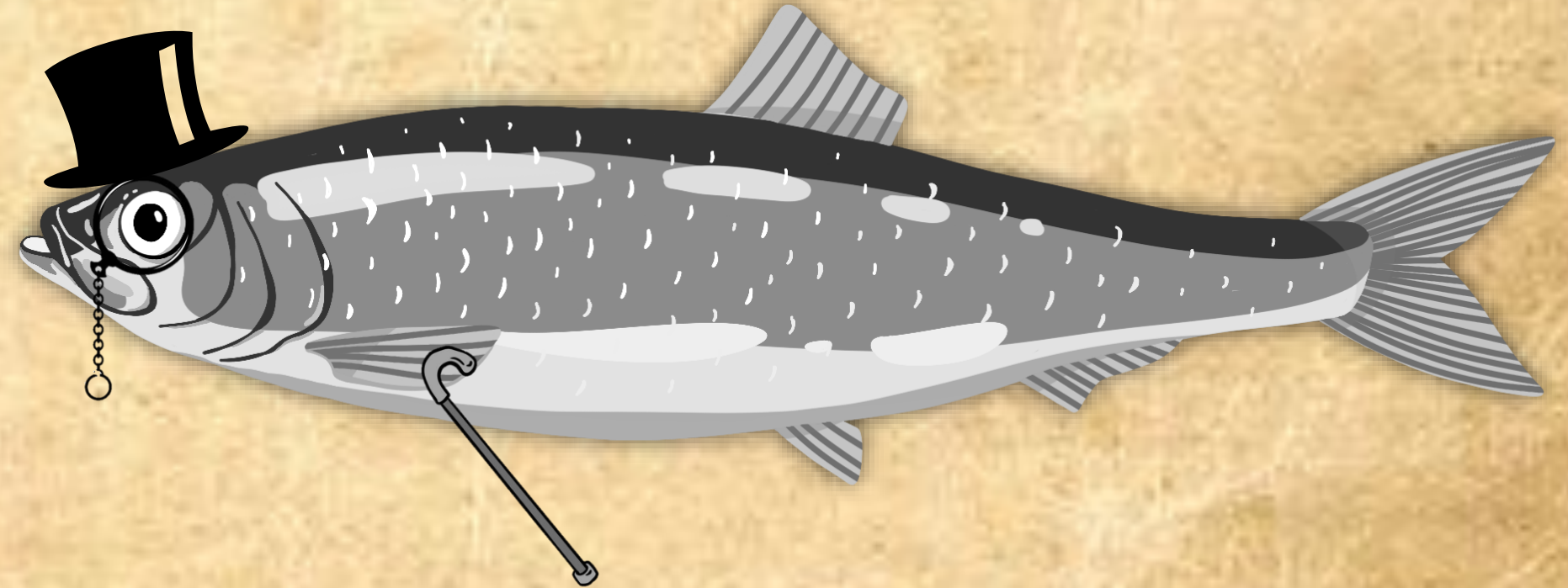
   Food and Agriculture Organization of the United Nations

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WANTED
Fast-growing herring



Also known as *Clupea harengus*

Atlantic herring

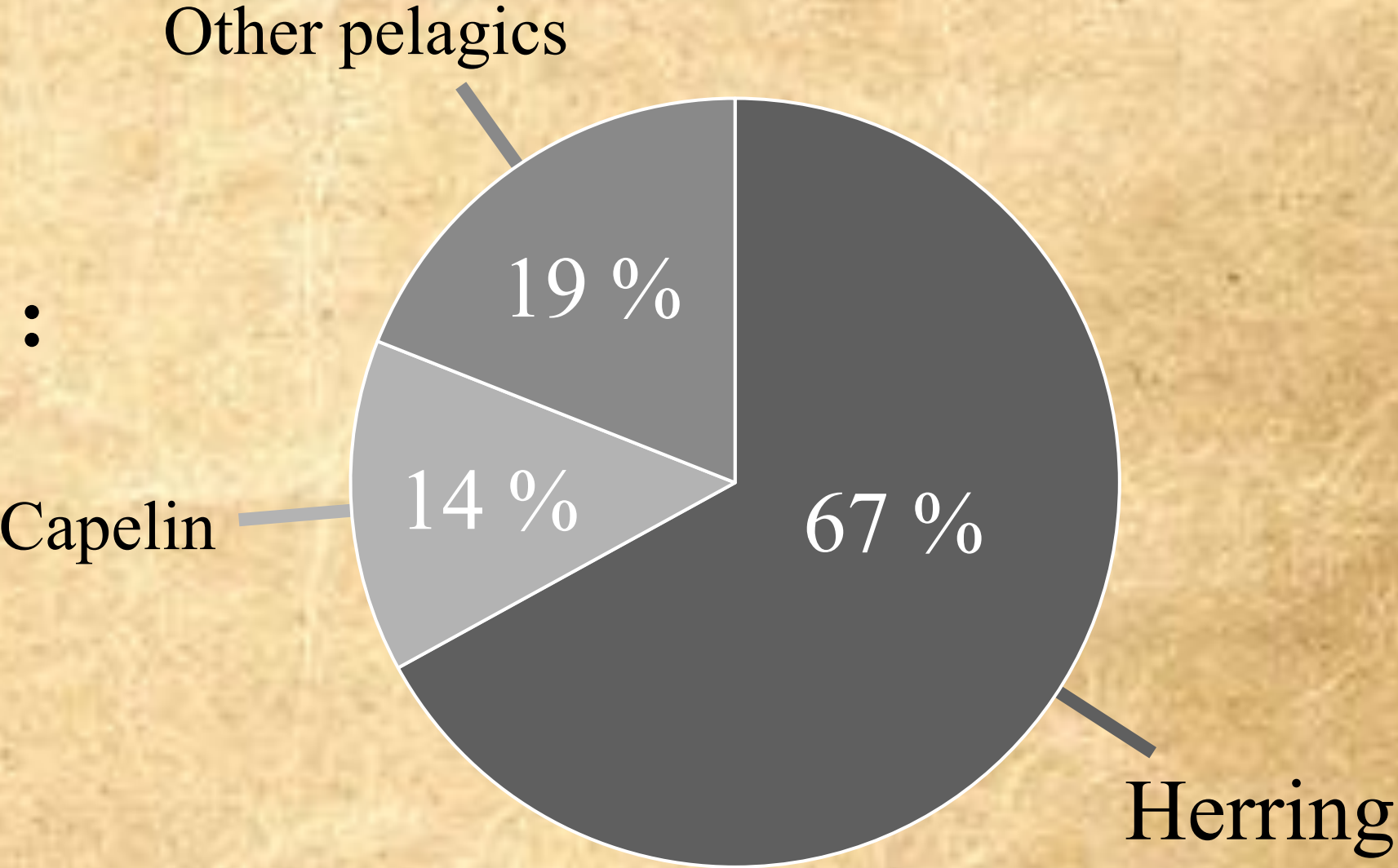


Most fished species in the world

Economic importance in eastern Canada :

- 28,7 M \$ in revenues

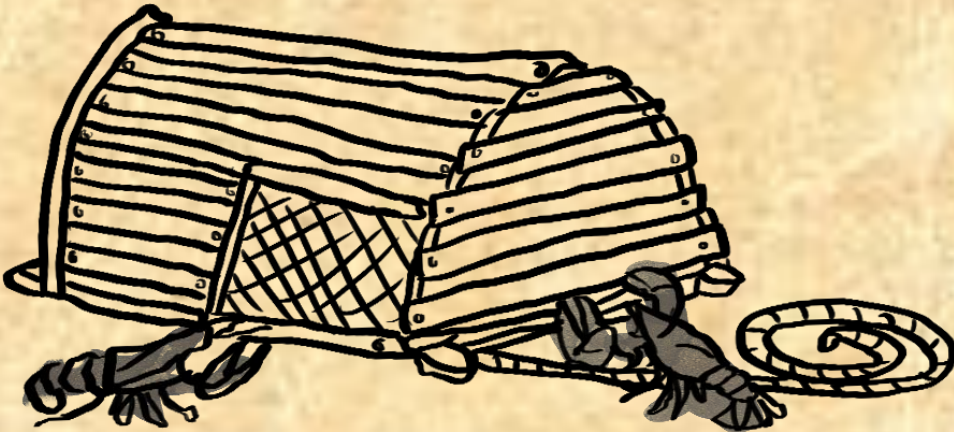
In Canada (2021)



Sources: FAO (2024), DFO (2022)

Atlantic herring

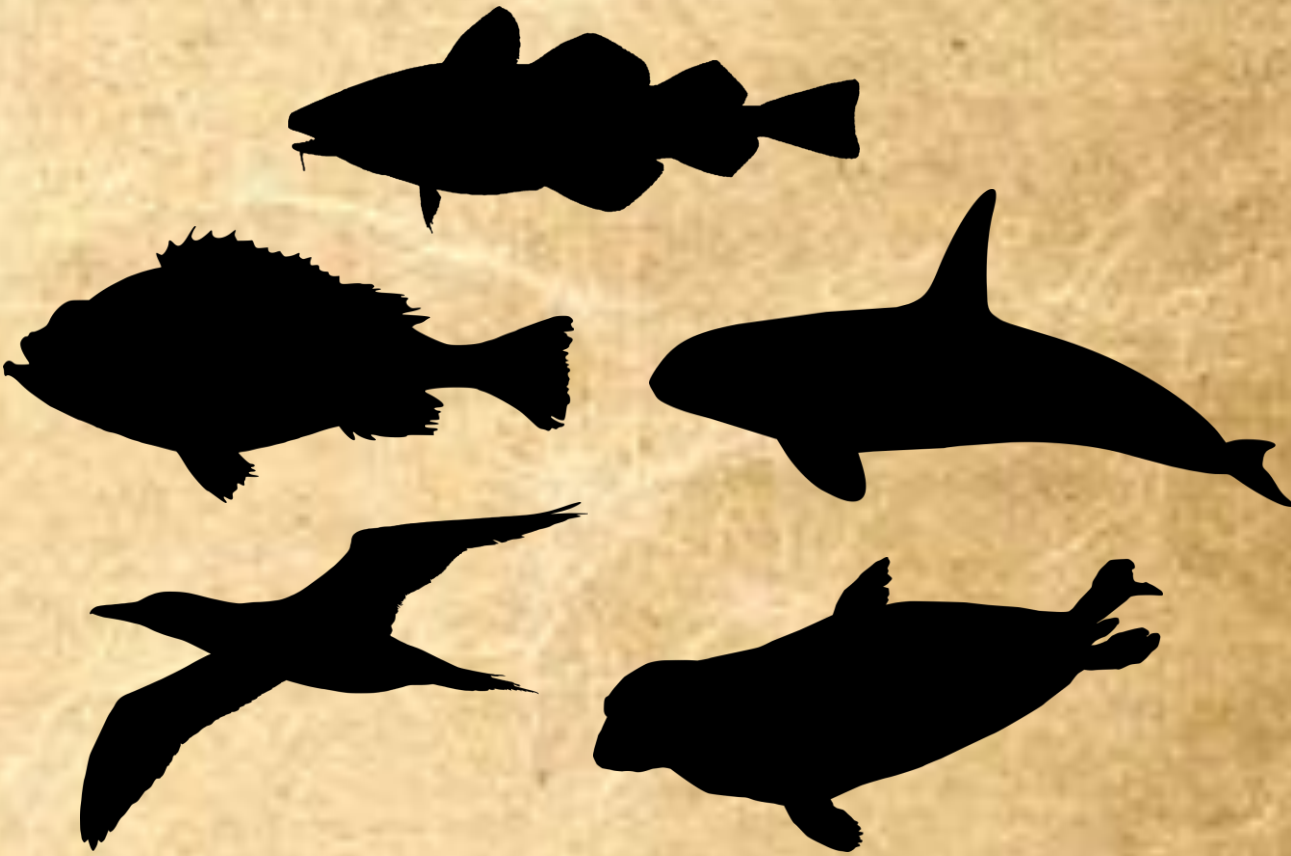
Bait of choice



Cultural importance



Ecological importance



Sources: DFO (1998), Grabowski et al. (2010), FAO (2024)

Stocks

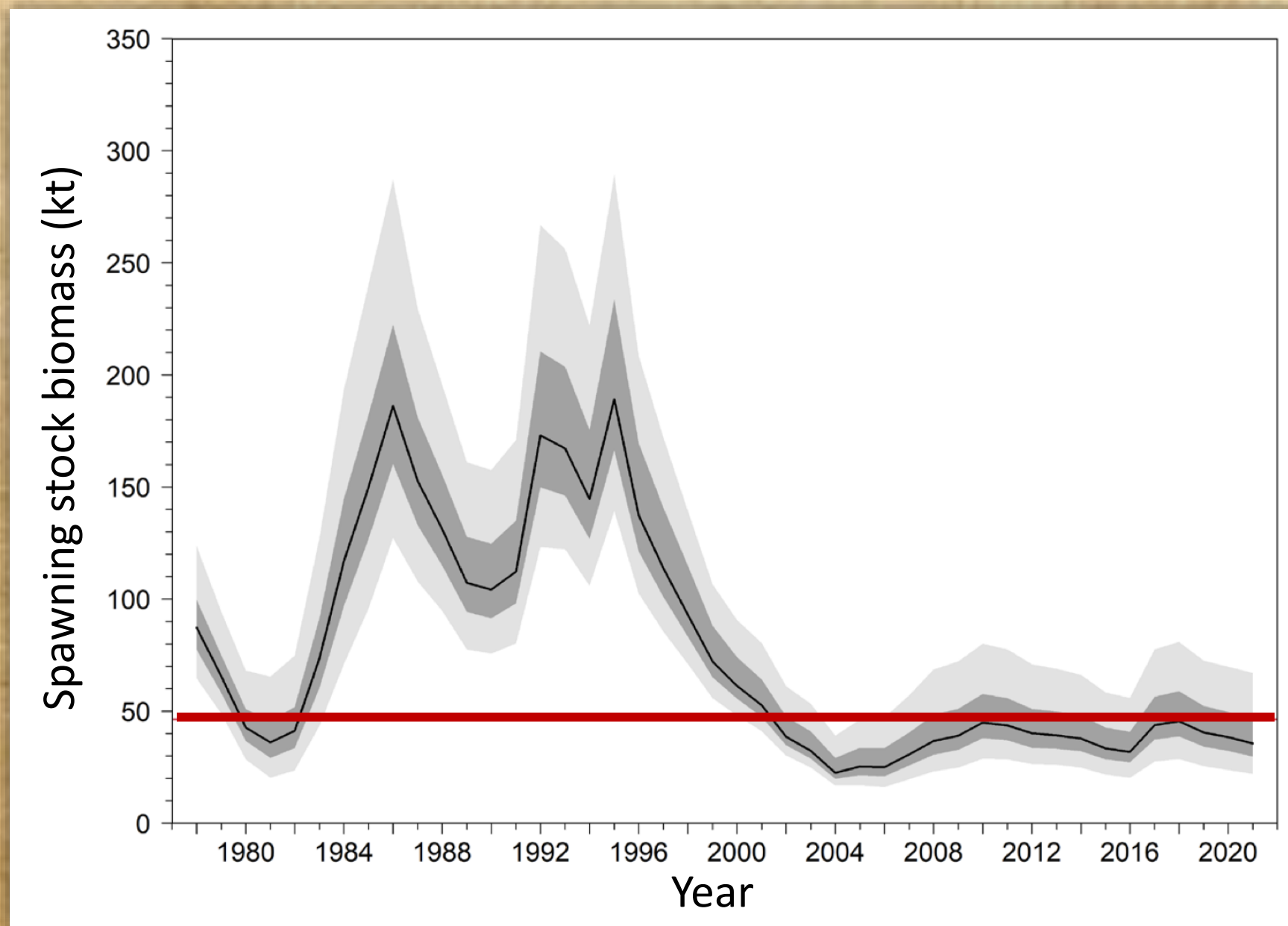
- 5 stocks have been in decline over the last 30 years
- Spring and fall spawners in the southern gulf of St. Lawrence



Sources: Trochta et al. (2020)

Southern gulf of St. Lawrence

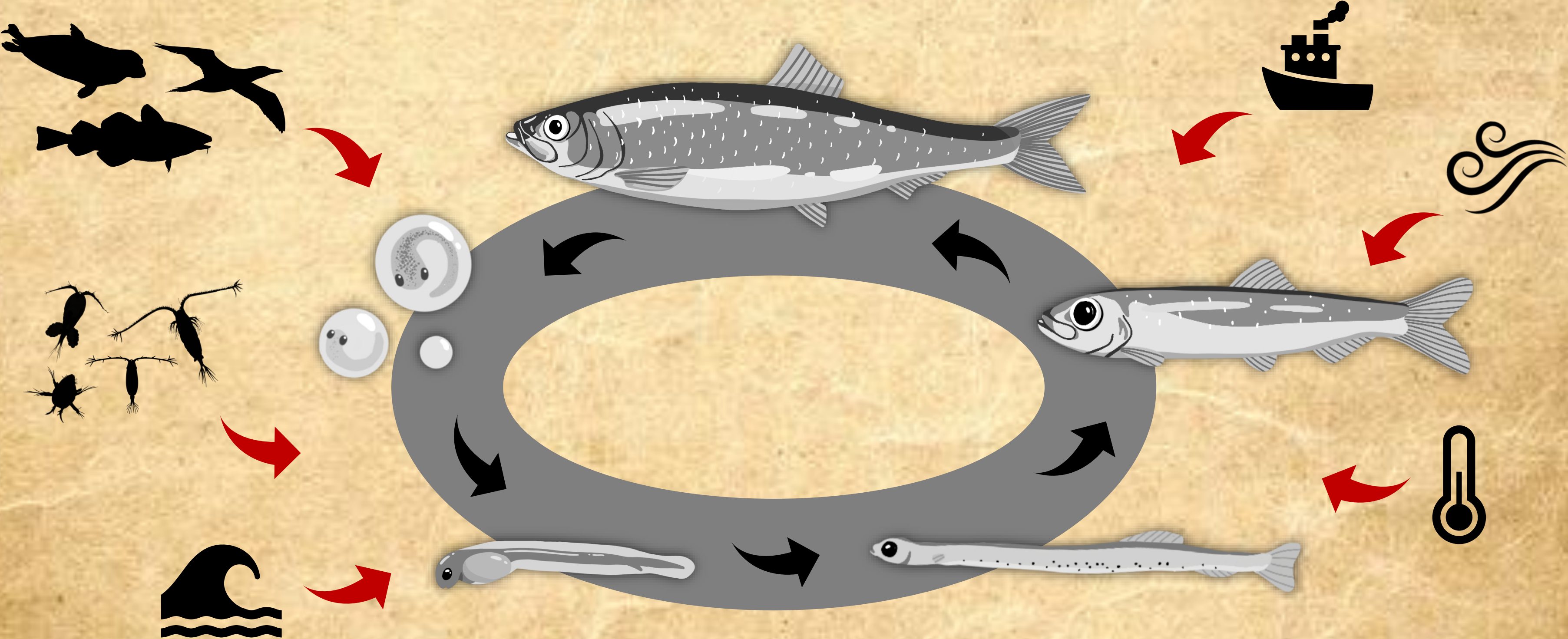
Spring spawners



- Stock collapse in the late 1990s
- In critical condition since 2002
- Fisheries closure in 2022

Sources: DFO (2022)

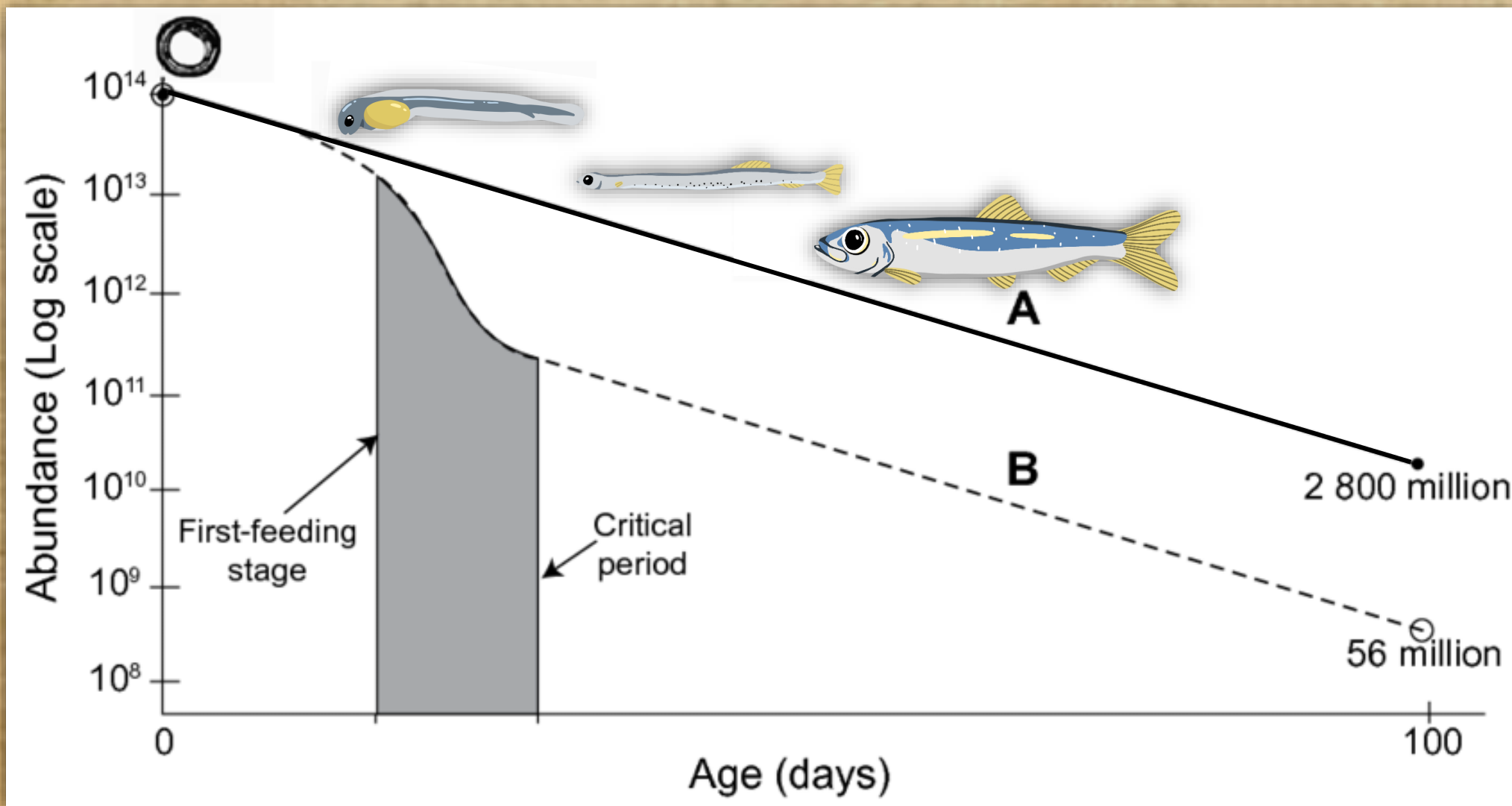
Recruitment



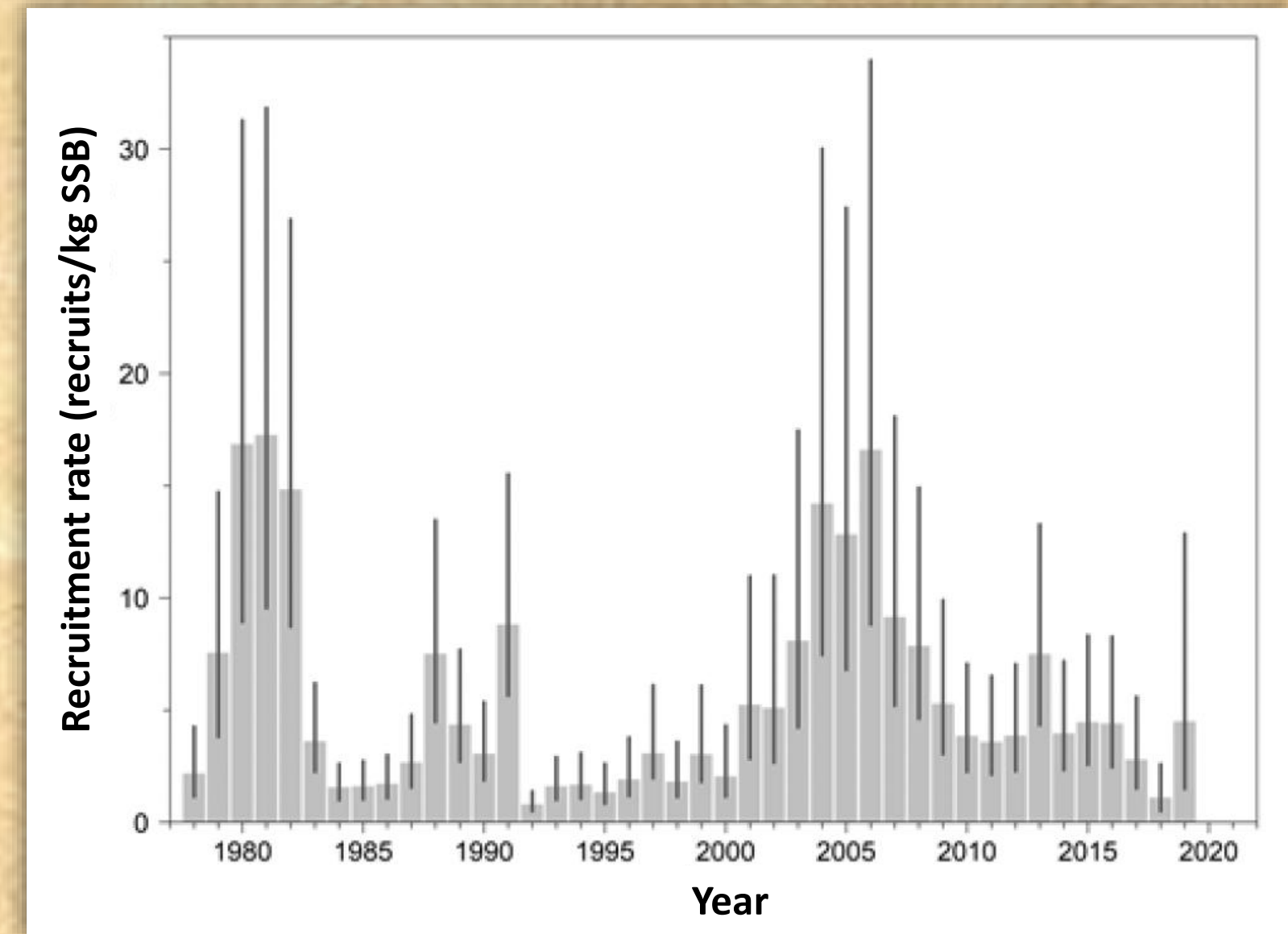
Sources: Ricker (1954, 1975), Houde (1987), Anderson (1988)

Critical period

- Transition from endogenous to exogenous feeding
- High vulnerability to biotic and abiotic factors
- > 99 % mortality



Recruitment variability



Sources: Hjort (1914), Houde (2008), DFO (2022)

Growth-survival paradigm

Bigger is better

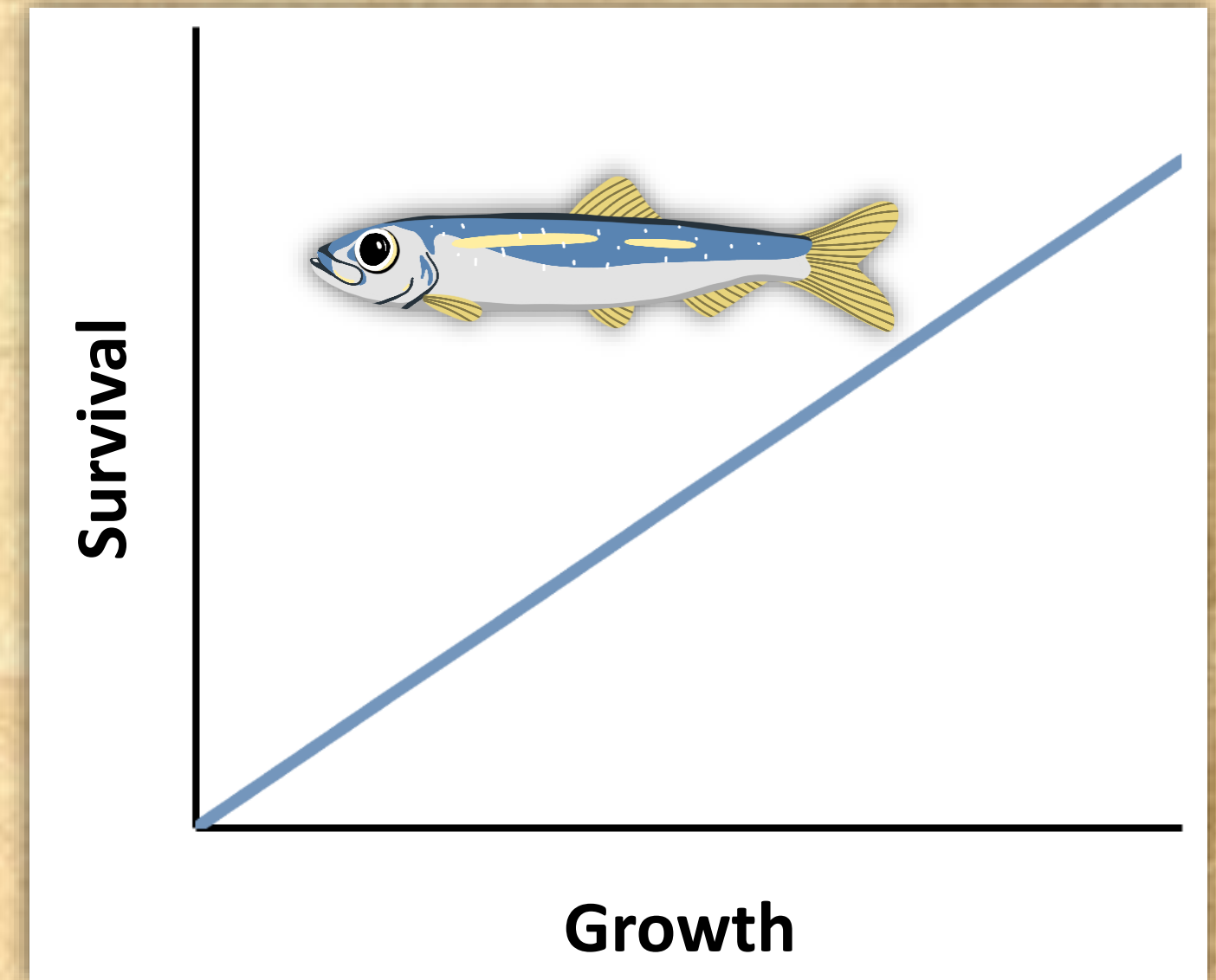
Larger individuals are less vulnerable to predators

Stage duration

Fast-growing larvae reach metamorphosis at an earlier age

Growth-selective predation

Higher survival of faster-growing individuals, due to their higher health status

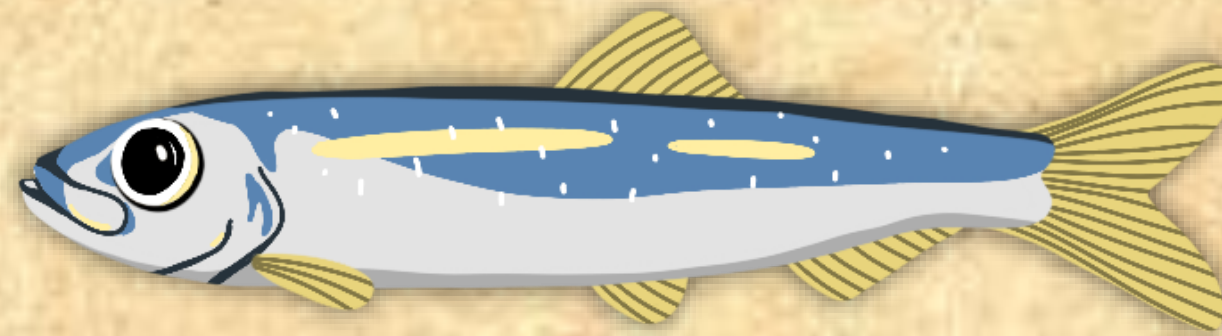


Sources: Chambers & Leggett (1987), Miller et al. (1988), Takasuka et al. (2003, 2007)

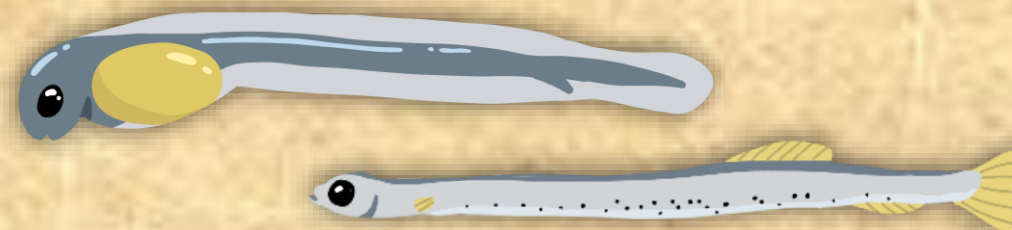
Objectives

Explore, for spring spawning herring in the southern gulf of St. Lawrence, the links between recruitment strength and growth...

1) In the first year of life



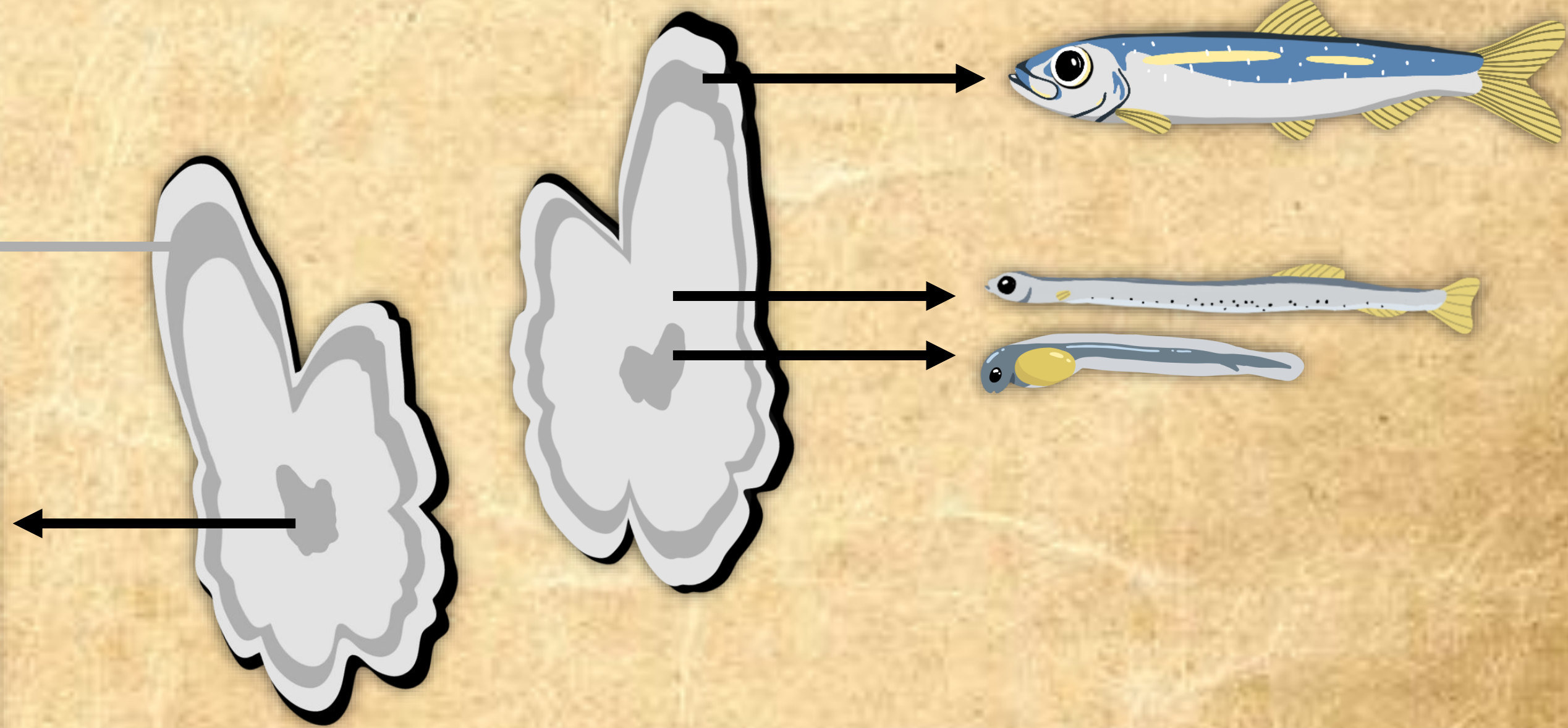
2) In the first weeks of life



Otoliths

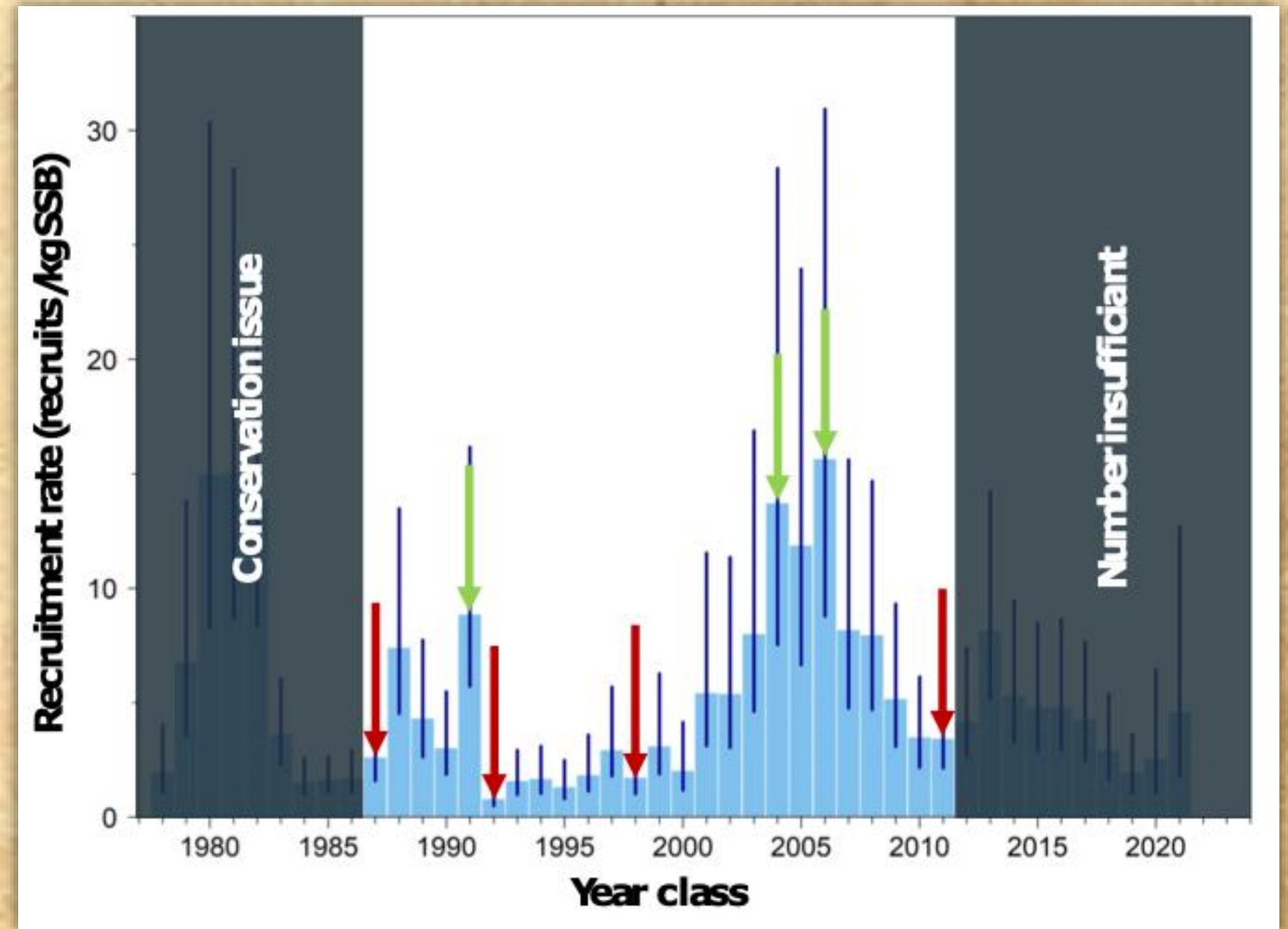
Annulus (1 year)

Daily increments



Otoliths

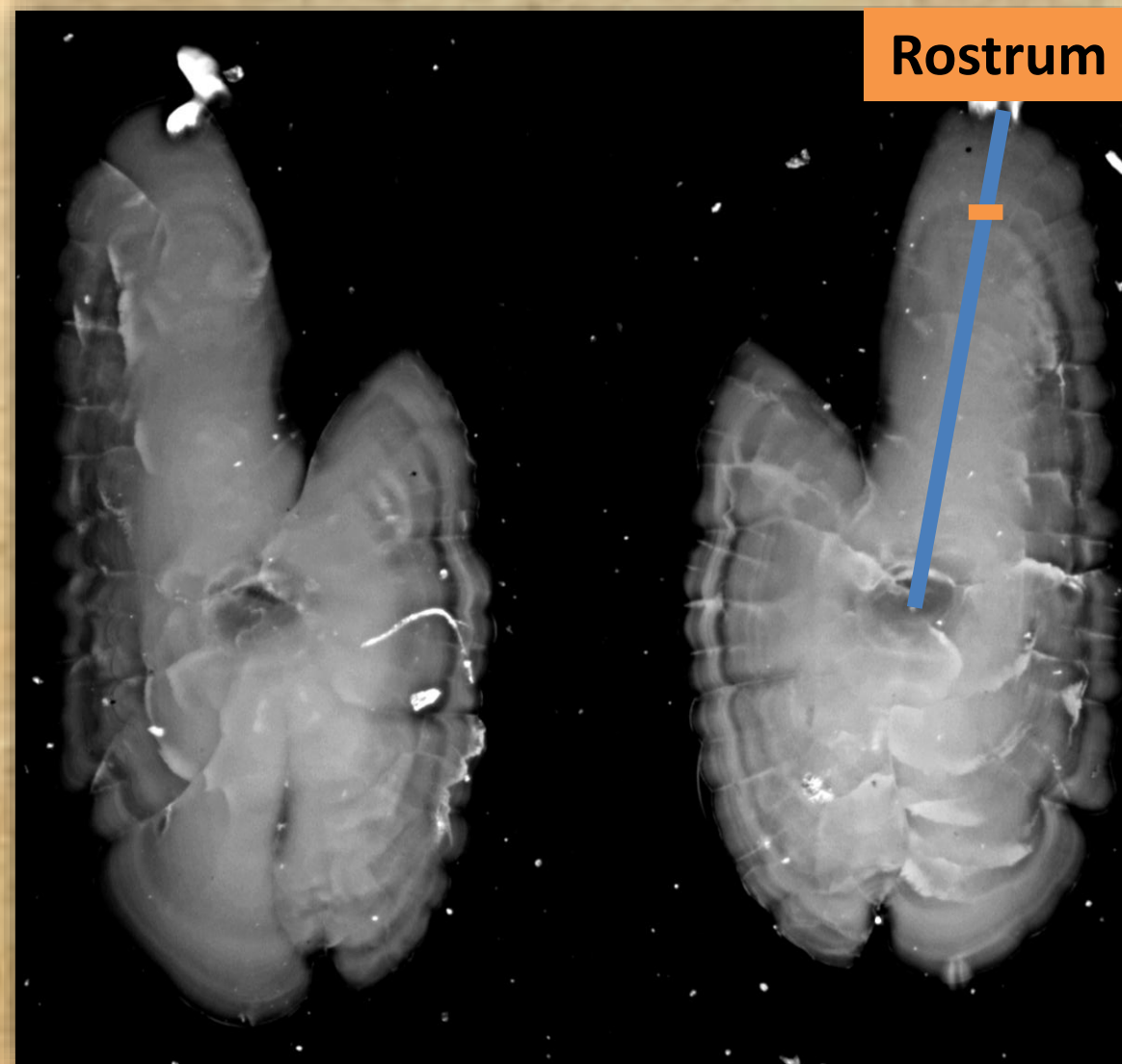
- 7 year-classes were selected over the 1986-2011 period
- Random selection of 30 otoliths from one year old fish



Growth measures

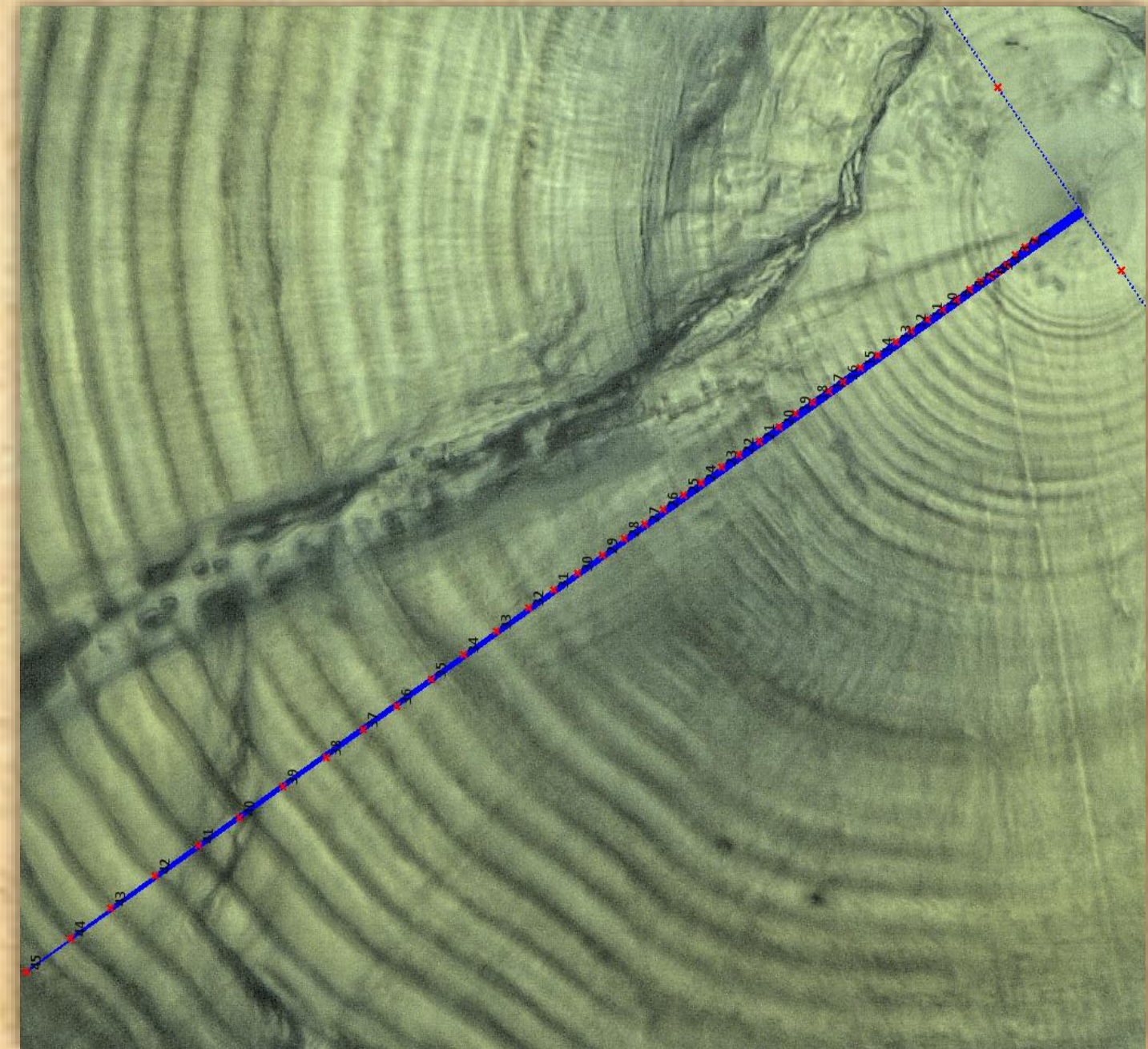
Cumulative 1-year growth

Measured in the rostrum



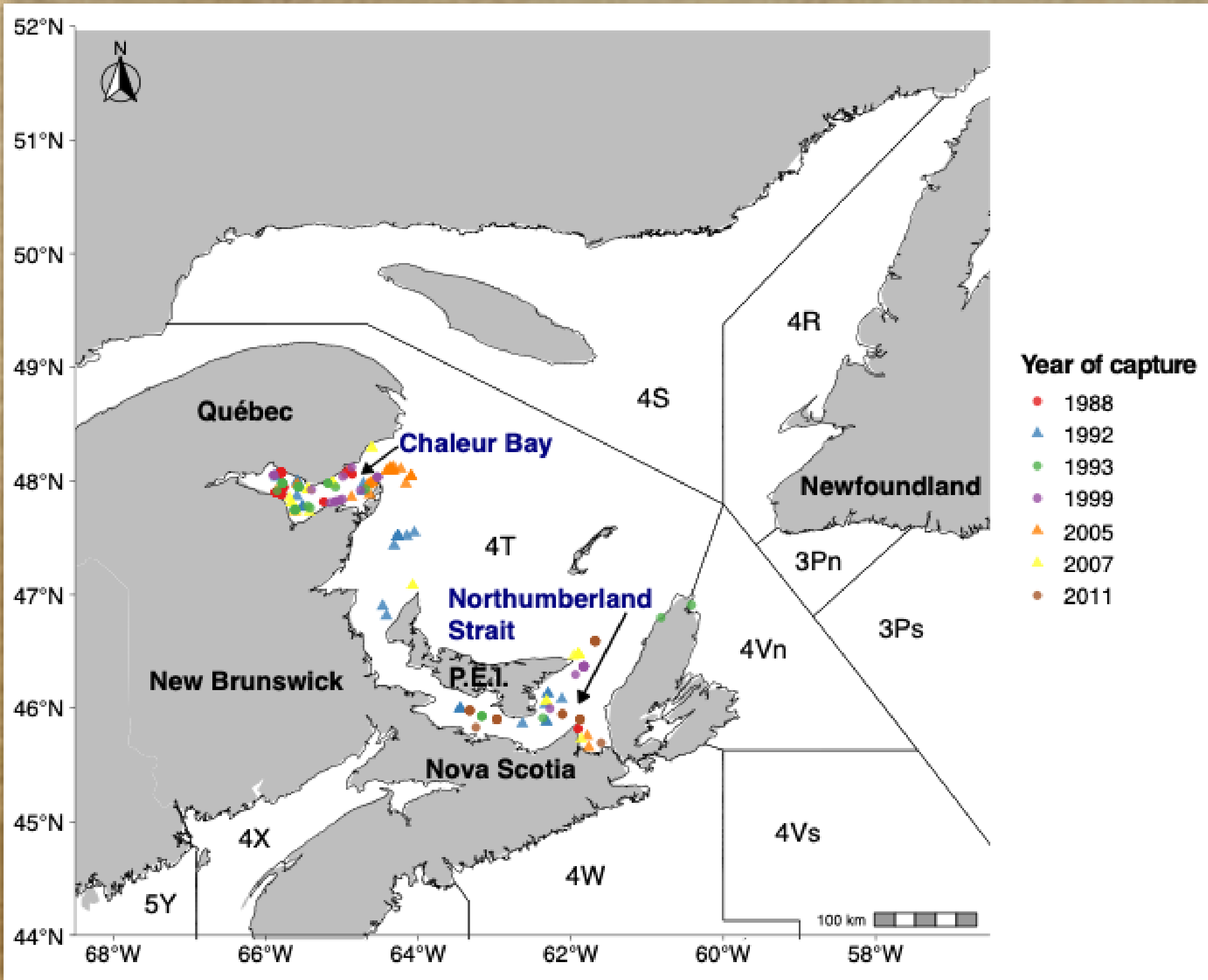
Daily growth

Polishing and 40 increments reading



Sources: Campana (1992)

Origin of samples

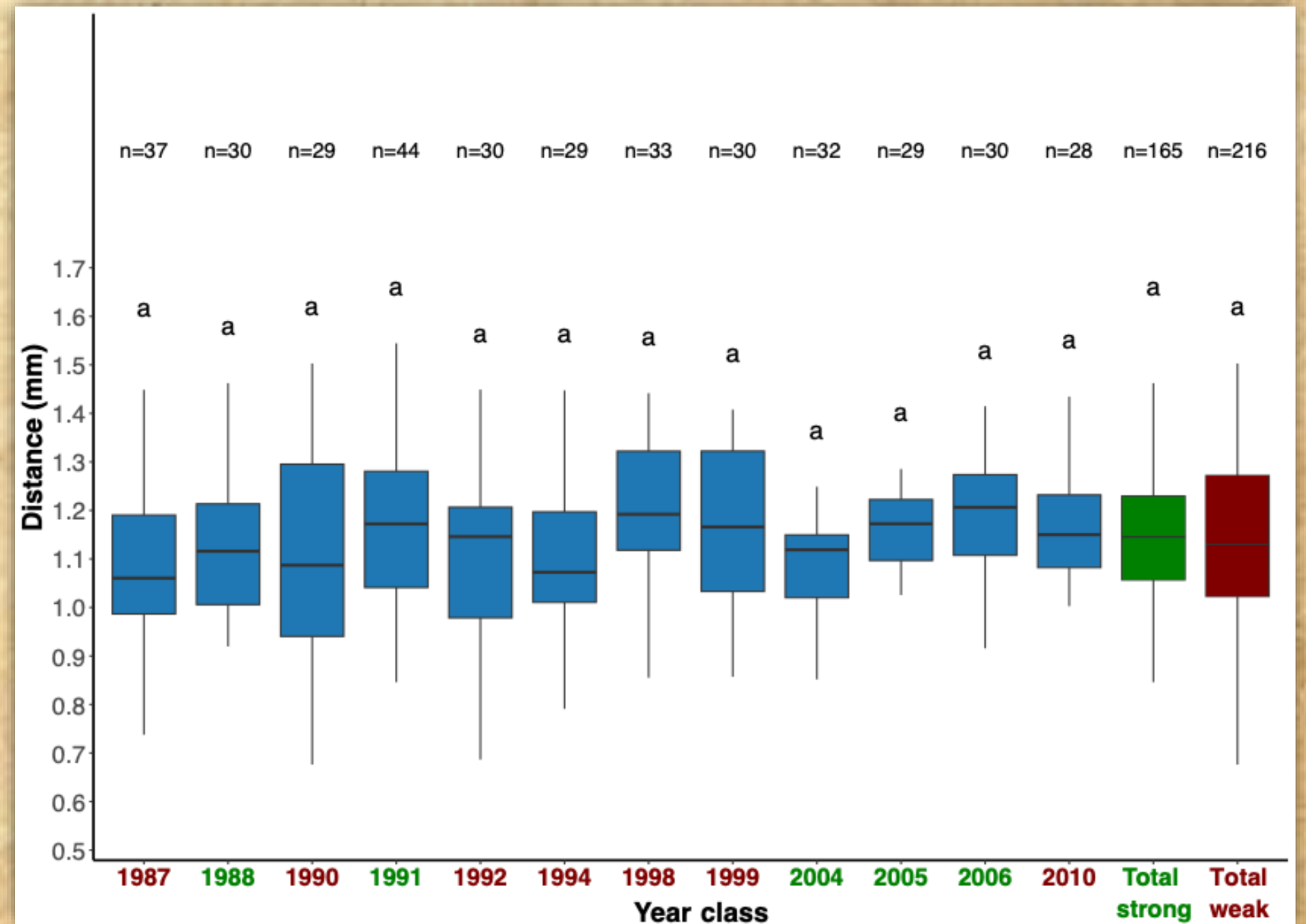


- Majority collected in the Chaleur Bay and Northumberland Strait
- Major spawning and feeding grounds for juveniles
- 210 otoliths were analyzed for daily growth

One-year growth

Analysis of variance

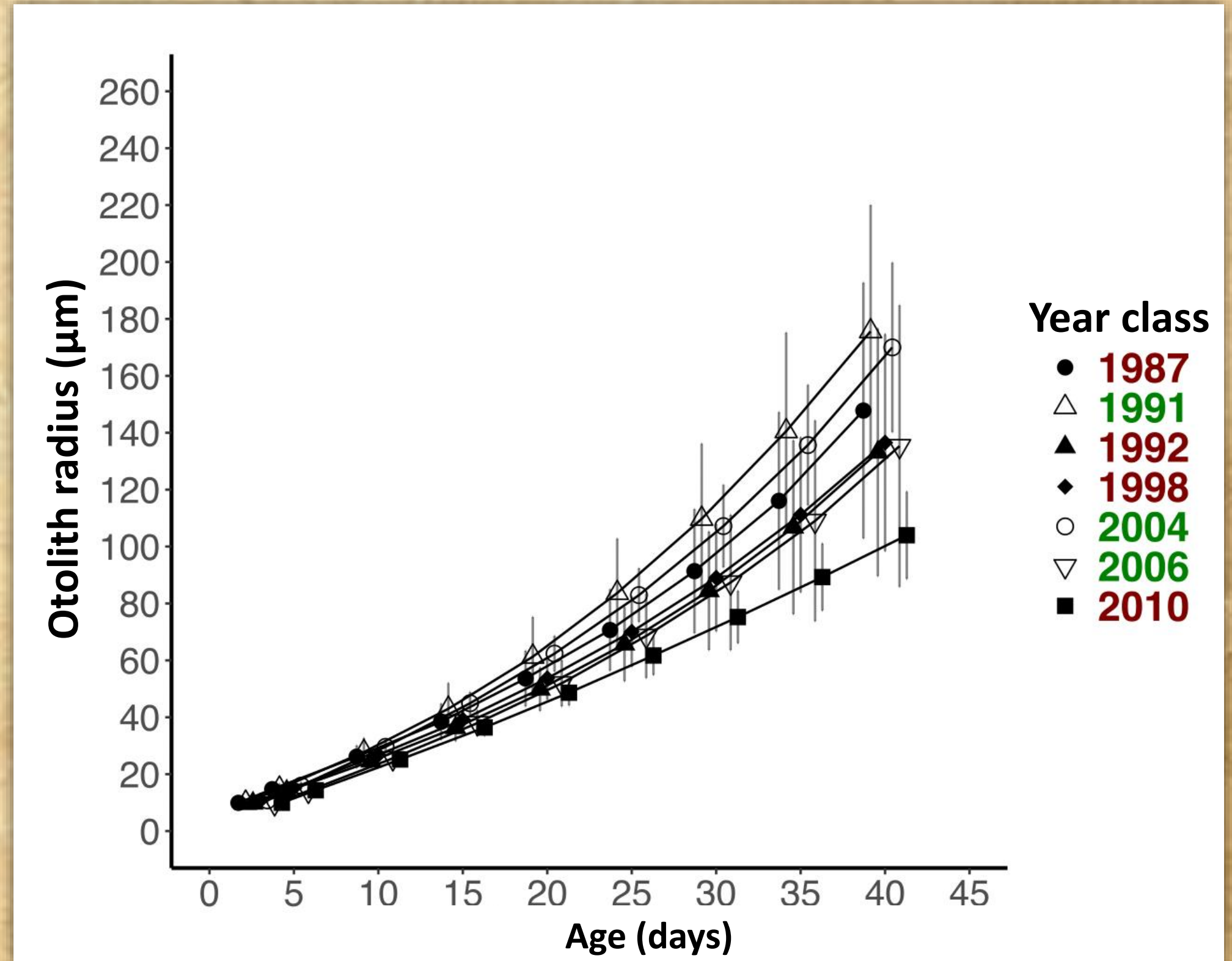
- Effect of year class : significant ✓
- Tuckey's HSD : non significant for any pairwise comparison ✗
- Effect of recruitment : non significant ✗



Daily growth

Repeated Measures Multivariate Analysis of Variance

- Effect of year class :
significant ! ✓



Age of divergence

Tukey's HSD

Recruitment	Year class	Increment																																												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40					
strong vs. weak	1987-1991																																													
	1987-2004																																													
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	1998-2006																																													
	2004-2010																																													
	2006-2010																																													
	strong vs. strong	1991-2004																																												
1991-2006																																														
2004-2006																																														
weak vs. weak	1987-1992																																													
	1987-1998																																													
	1987-2010																																													
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Effect of recruitment

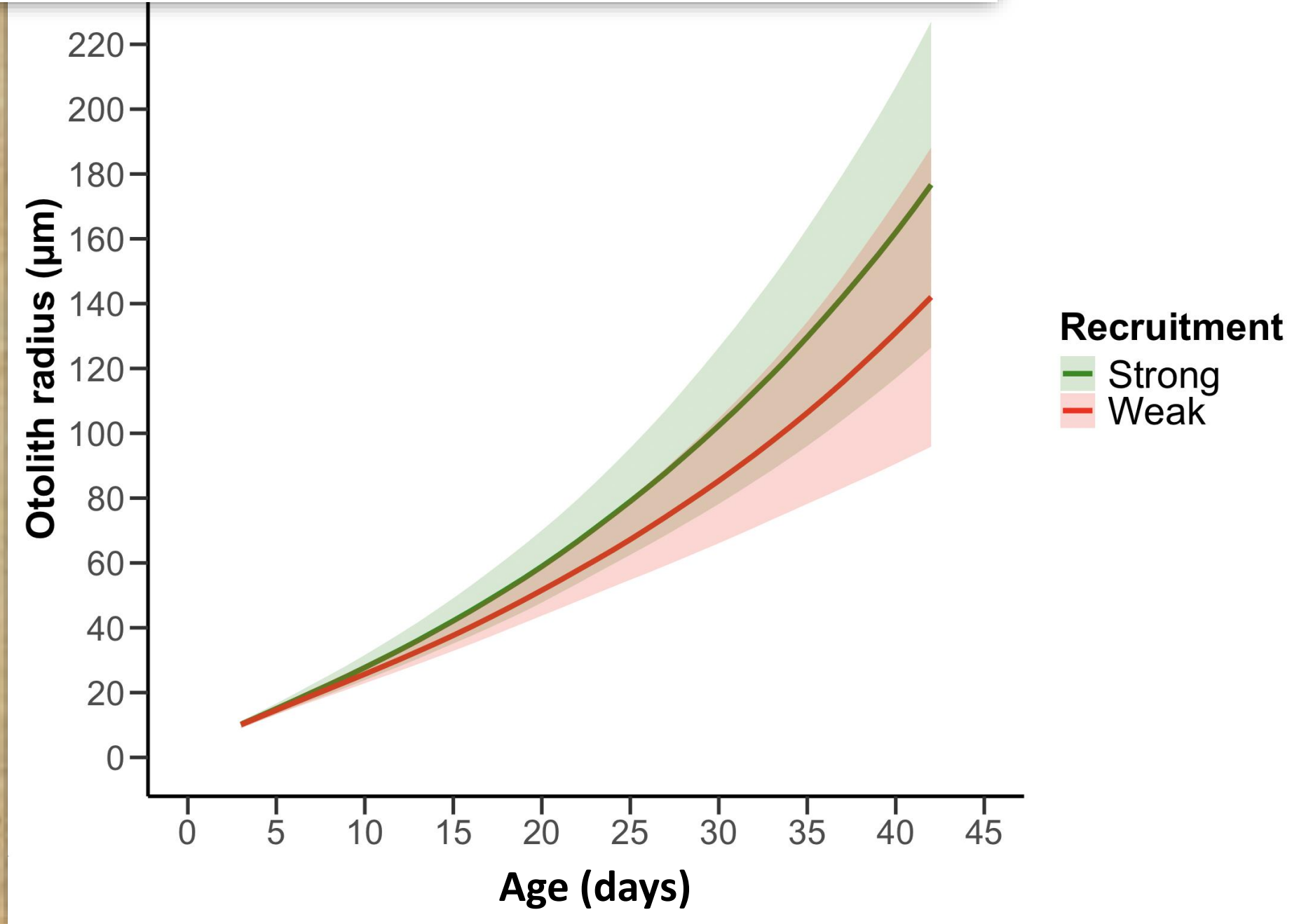
Recruitment	Increment																																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40			
Weak vs. Strong	Grey	Grey	Grey	Grey	Grey	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow

Tukey's HSD



Contrasts

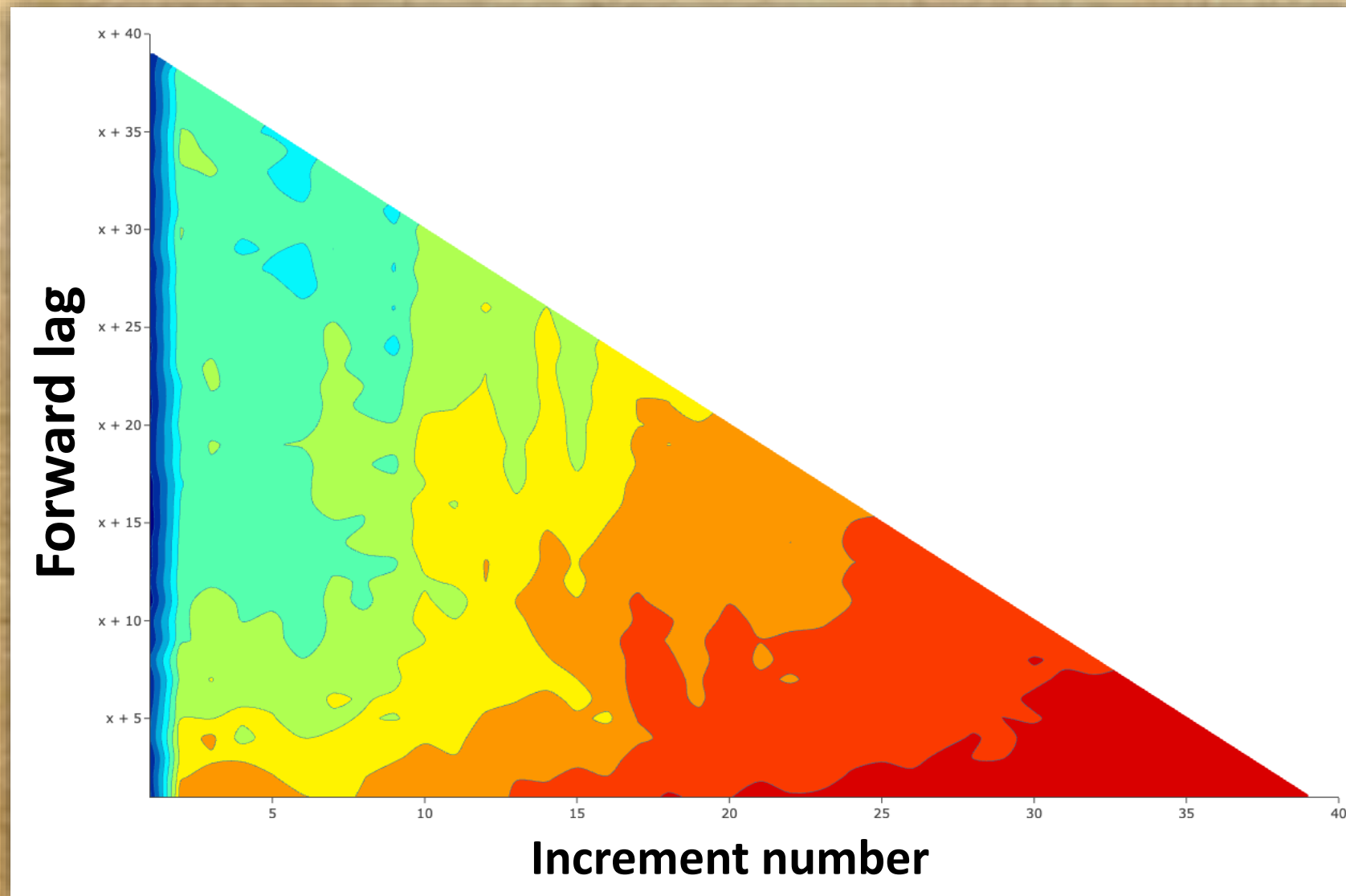
- Low-recruiting year classes have significantly lower growth trajectories than high-recruiting year classes



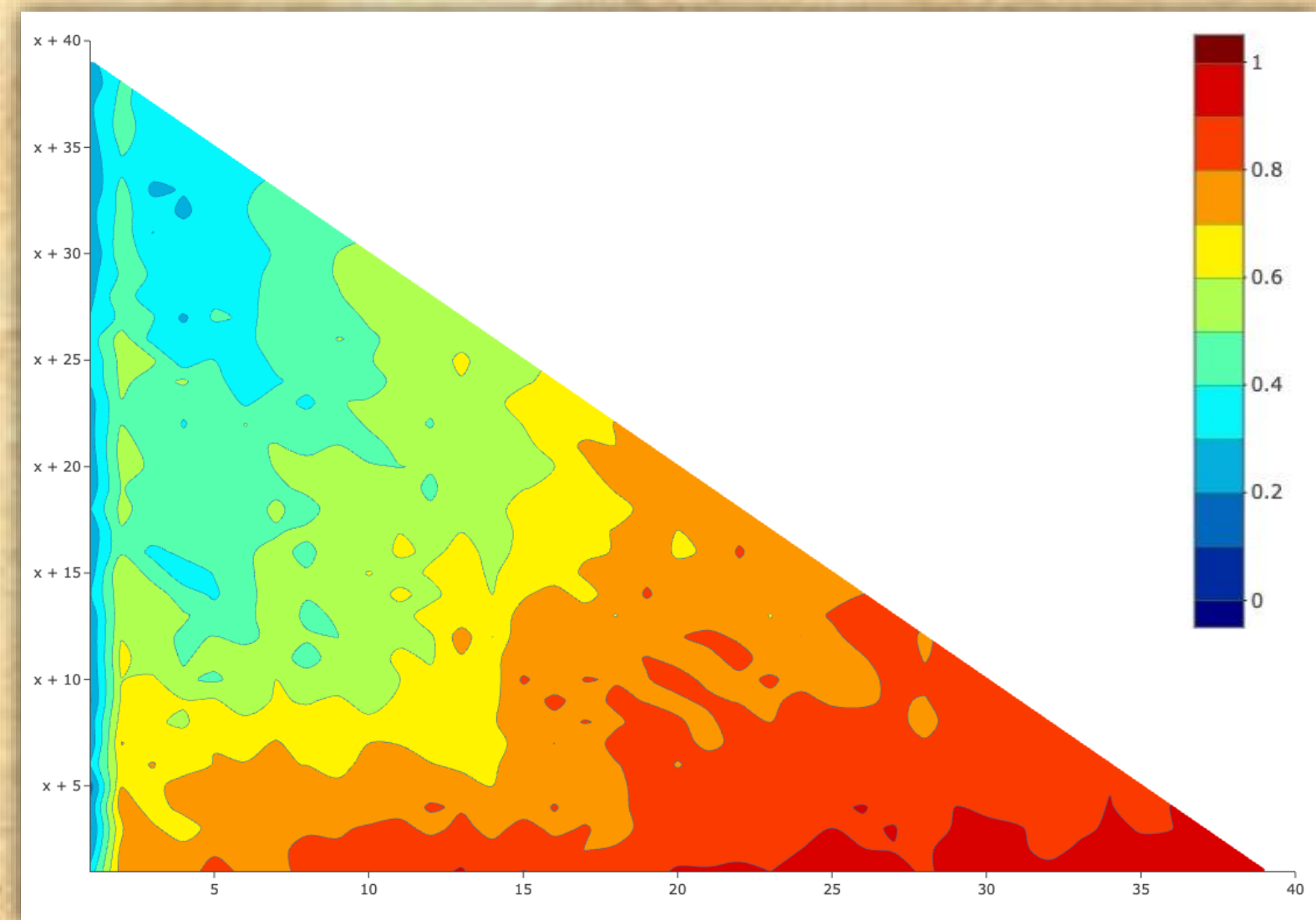
Growth autocorrelation

- How well growth at one time point predicts growth at future time points

Weak recruitment

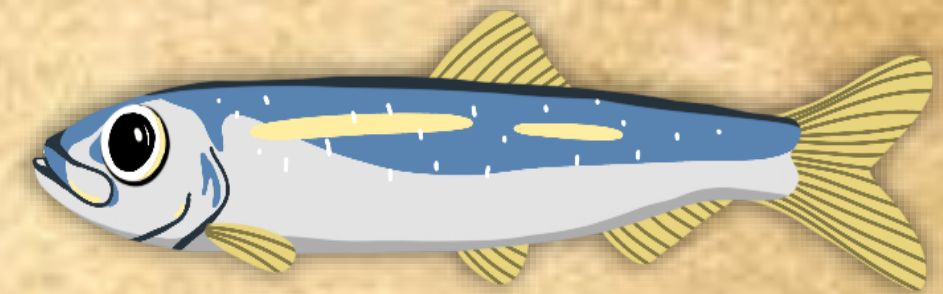


Strong recruitment



Take-home messages

- Year classes of strong recruitment generally exhibited higher growth during their first 40 days compared to year classes of weak recruitment, with stronger growth autocorrelation occurring sooner.
- Year classes of weak and strong recruitment diverged in their average larval growth trajectories as early as the 6th increment.
- We did not find a clear relationship between cumulative growth over the first year of life and recruitment. Other mechanisms must therefore regulate growth following the larval stages.





MUCHAS GRACIAS!

Advisors

- Jacob Burbank (DFO)
- Dominique Robert (UQAR)

Otolith analysis

- Pierre Lavoie (UQAR)
- Mélanie Boudreau (DFO)
- Hélène Dionne (DFO)
- Sylvie Robichaud (DFO)

Sample collection

- Technicians from DFO

Statistical analyses

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- Safouane Khamassi

Illustrations

- Charlotte Gauthier

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A thought bubble with a scalloped border, containing the text "Questions?".

Questions ?

