SUPPLEMENTARY INFORMATION

Age, not growth, explains larger body size of Pacific cod larvae during recent marine heatwaves

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$R^2 = 0.90$
$R^2 = 0.80$
$R^2 = 0.73$
$R^2 = 0.83$
$R^2 = 0.91$
$R^2 = 0.93$
$R^2 = 0.85$

Total length, mm

20
15
10
5

50   100   150

Otolith radius, microns
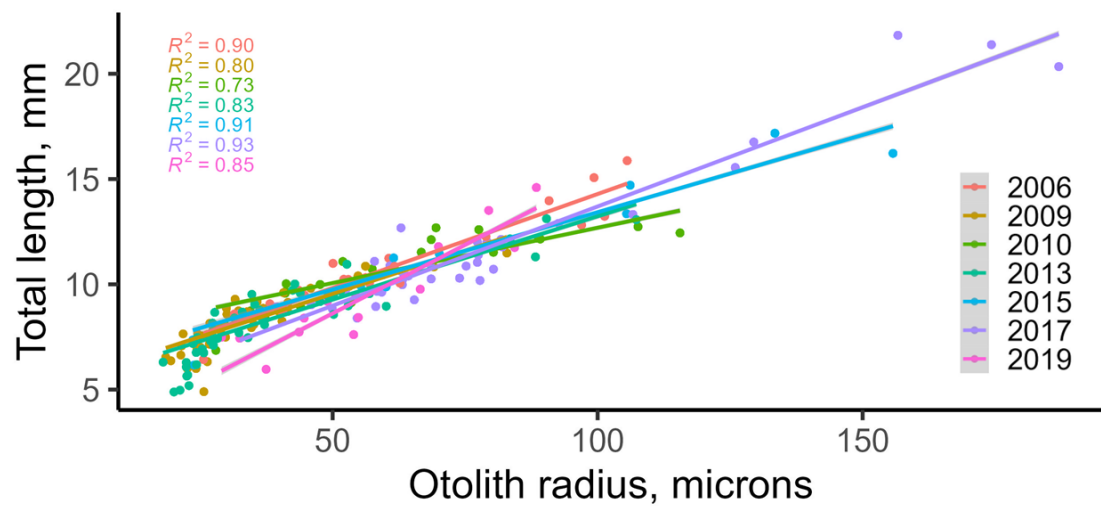
2006
2009
2010
2013
2015
2017
2019

Figure S1. Total length (mm) by otolith radius at capture (microns) for larvae collected in 2006, 2009, 2010, 2013, 2015, 2017, 2019. Simple linear model fits are included for reference.

Table S1. ANOVA results (Type III sum of squares) for the model to predict hatch date based on fixed effects of marine heatwave status and random effect of year of capture and station.

Term	Value (SE)	t-value	χ^2_{df}
Intercept	125.30 (3.64)	34.48	1183_1
MHW (referenced to Before)	-18.54 (5.61)	-3.31	10.93_1

Table S2. Mean (SD) temperature in January through April at the surface (0 to 30 m, $T_{J-A,SST}$) and at depth (100 to 250 m, $T_{J-A, 100-250 m}$) and mean (SD) temperature during incubation of Pacific Cod larvae based (Incubation Temp). Data are from GAK1 (http://research.cfos.uaf.edu/gak1/data/).

Year	$T_{J-A, SST}$	$T_{J-A, 100-250 m}$	Incubation Temp
2006	4.83 (0.39)	5.51 (0.47)	5.17 (0.08)
2009	3.39 (0.42)	4.93 (0.43)	4.57 (0.02)
2010	4.68 (0.32)	5.73 (0.41)	5.60 (0.09)
2013	4.08 (0.33)	5.38 (0.27)	5.10 (0.02)
2015	5.96 (0.51)	6.71 (0.42)	6.34 (0.18)
2017	4.79 (0.49)	5.97 (0.80)	5.07 (0.32)
2019	5.67 (0.48)	6.89 (0.29)	6.64 (0.21)

Table S3. Linear regression ($n = 7$) between mean annual hatch date and mean temperatures during January to April at 100 to 250 m depth ($T_{J-A, 100-200m}$). Model terms and their value (SE = standard error) are included with t-value and p-value.

Term	Value (SE)	t-value	p-value
Intercept	204.10 (23.11)	8.83	0.0003
Mean temperature (°C)	-14.68 (3.91)	-3.76	0.013

Table S4. Results from models to predict size-at-age (TL, mm) based on age and marine heatwave status (MHW) as a fixed effect. Model term and their value (SE = standard error) are included with t-value, and p-value. Age was scaled for analysis.

Term	Value (SE)	t-value	χ^2_{df}	p-value
Intercept	8.66 (0.242)	33.70	1282.8_1	<0.0001
Scaled Age, first degree	108.81 (0.574)	191.98	35972.5_2	<0.0001
Scaled Age, second degree	-7.54 (0.540)	-13.67		<0.0001
MHW (referenced to Before)	-0.75 (0.377)	-1.835	3.9_1	0.047
Scaled Age, first degree:MHW	-4.02 (2.916)	-0.934		0.769
Scaled Age, second degree:MHW	9.04 (2.008)	3.80	26.1_2	<0.0001

Table S5. Marginal means extracted from linear mixed model to examine size-at-age for larval Pacific cod with year of collection as a random factor before and during & after marine heatwaves (MHWs) in the Gulf of Alaska. Age, days post hatch (dph), predicted total length (TL), and 95% confidence intervals are presented.

Before MHWs			During & after MHWs		
Age, dph	Predicted TL	95% CI	Age, dph	Predicted TL	95% CI
6	4.24	3.76-4.72	6	4.16	3.43-4.90
15	7.21	6.74-7.69	15	6.50	5.92-7.08
20	8.71	8.23-9.18	20	7.80	7.24-8.37
25	10.11	9.63-10.58	25	9.12	8.56-9.69
45	14.90	14.41-15.48	45	14.85	14.23-15.47

Table S6. ANOVA results (Type III sum of squares) for the model to predict age (square-root transformed) based on fixed effects of total length at capture (TL, µm) year of capture. Intercept corresponds to 2006 and length at capture = 0.

Predictor	Sum of squares	$F_{dn,dd}$	p-value
Intercept	2.57	$13.81_{1,187}$	0.0003
Length at capture	12.64	$67.86_{1,187}$	<0.0001
Year	6.86	$6.14_{6,187}$	<0.0001
Length:Year	4.32	$3.87_{6,187}$	0.0011