**Metadata for:**

Marine Heatwaves alter the nursery function of coastal habitats for juvenile Gulf of Alaska Pacific cod

Hillary L. Thalmann1,\*, Benjamin J. Laurel2, L. Zoe Almeida1, Kaitlyn E. Osborne1, Kaylee Marshall1, Jessica A. Miller1

1Oregon State University Department of Fisheries, Wildlife, and Conservation Sciences;

Coastal Oregon Marine Experiment Station; Hatfield Marine Science Center, 2030 SE Marine Science Dr., Newport, OR 97365

2NOAA Alaska Fisheries Science Center, Hatfield Marine Science Center, 2030 SE Marine Science Dr., Newport, OR 97365

\*Corresponding author: [hillary.thalmann@oregonstate.edu](mailto:hillary.thalmann@oregonstate.edu)

ORCIDs:

HLT: 0000-0002-2112-5131. BJL: [0000-0001-7150-0879](https://nam04.safelinks.protection.outlook.com/?url=http%3A%2F%2Forcid.org%2F0000-0001-7150-0879&data=05%7C02%7Chillary.thalmann%40oregonstate.edu%7C42f7a6b818ed4155b07408dc107286b1%7Cce6d05e13c5e4d6287a84c4a2713c113%7C0%7C0%7C638403331273121809%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=OXXpJW%2BEk3FwJs1OPP%2B22%2FH4cqTC8%2BhxvPGiAhLfEVc%3D&reserved=0). LZA: 0000-0003-0280-5964.

KEO: 0009-0003-0880-7984. JAM: 0000-0002-6491-4085

The following R script files (indexed ScX) contain all analyses and plots in Thalmann et al. (available in a GitHub Data Repository).

Data files (indexed DX) that pair with the script are indicated (also available in GitHub Data Repository).

[Sc1] Abundance\_Size\_Condition.R

[D1] SiteData.csv

[D2] SeineData.csv

[D3] Size\_Condition\_Raw.csv

[Sc2] DailyTemperature\_HeatwaveClasses.R

[D4] TridentBay\_DailyTemperature.csv

[Sc3] DietComposition.R

[D5] StomachFullness\_Raw.csv

[D6] Size\_Condition\_ROutput.csv

[D7] PreyData\_Raw.csv

[Sc4] Diet\_NMSOrdinations.R

[D8] JulyPSIRI\_ROutput.csv

[D9] AugPSIRI\_ROutput.csv

[D10] SamplingData\_Master.csv

[D6] Size\_Condition\_ROutput.csv

[D4] TridentBay\_DailyTemperature.csv

[D2] SeineData.csv

[D1] SiteData.csv

[Sc5] Otolith\_BackCalculations.R

[D11] OtolithIncrements\_Raw.csv.csv

[Sc6] Growth\_LinearMixedEffectsModels.R

[D12] BackCalculatedGrowth\_ROutput.csv

[D13] JulyNMS\_ROutput.csv

[D14] AugNMS\_ROutput.csv

[D15] StomachFullness\_ROutput.csv

[D4] TridentBay\_DailyTemperature.csv

[D16] Final21Days\_withDate.csv

[D2] SeineData.csv

[D10] SamplingData\_Master.csv

[D6] Size\_Condition\_ROutput.csv

[Sc7] PredictedGrowth.R

[D12] BackCalculatedGrowth\_ROutput.csv

[D6] Size\_Condition\_ROutput.csv

[D2] SeineData.csv

[D10] SamplingData\_Master.csv

[Sc8] SamplingMap.R

Information about the code:

+ Each script file includes code for the analyses or plots indicated.

+ All scripts contain additional information about analyses in comments throughout, with general meta-data about the file in the header of the script.

Information about the data:

+ All of the above data files are called into their respective R script files, with many data files being called into multiple script files.

+ Data was obtained from collections of age-0 Pacific Cod captured near Kodiak Island during 2006-2010, 2012-2019 - see manuscript for details.

+ Details about data formatting and variable names are below.

>**Site Data**

>Files: [D1] SiteData.csv

> Rows represent sampling sites

> Columns:

> SITEID: unique secondary key identifier for sampling sites

> Site: Site Name

> Bay: Anton Larsen Bay (ALB), Cook Bay (Cook), and Offshore. Offshore sites were excluded from this analysis. See Figures S6 for a sampling map of these bays.

>Habitat: Dominant submerged aquatic vegetation at the site

>LatDeg: Degrees of latitude

>LatMin: Degree minutes of latitude

>LongDeg: Degrees of longitude

>LatDeg: Degree minutes of longitude

>**Seine Data**

>Files: [D2] SeineData.csv

>Rows represent beach seines

>Columns:

>SeineID: unique secondary key identifier for beach seines

>Month: Month of seine

>Year: Year of seine

>Date: Date associated with seine in year-month-day format

>SITEID: unique secondary key identifier for sampling sites

>Time: Time of beach seine

>SiteTemperature\_YSI: Temperature in degrees Celsius taken with a YSI at time of beach seine

>TotalGadidCount: Total number of gadids captured in beach seine

>No.PacificCod: Total number of age-0 Pacific Cod captured in beach seine

> **Fish Size and Condition Data**

> Files: [D3] Size\_Condition\_Raw.csv

>Rows represent individual age-0 Pacific Cod

> Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>SL\_mm: Standard Length of fish in mm

>TL\_mm: Total Length of fish in mm

>WholeBodyWW\_g: Whole body wet weight of fish in grams

>TOTAL\_Liver\_WW\_g: Total Liver wet weight of fish in grams

> Files: [D6] Size\_Condition\_ROutput.csv

\*Same as above, but includes the following as additional columns:

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>logSL: Log-transformed Standard Length

>logWeight: Log-transformed wet weight

>HSI: Hepatosomatic Index

>HSI\_numeric: verify HSI class is numeric in R

>LWResiduals\_All: Length-weight condition residuals based on a linear regression of logSL against logWeight for all fish across both months.

> **Temperature Data**

> Files: [D4] TridentBay\_DailyTemperature.csv

> Rows represent days

> Columns:

> Date: Date associated with temperature in year-month-day

> TridentTemp: Daily temperature value in degrees Celsius

> Month: Month associated with temperature

> Year: Year associated with temperature

>**Fish Stomach Fullness**

> Files: [D5] StomachFullness\_Raw.csv

>Rows represent individual age-0 Pacific Cod

> Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>StomachWW\_g: Whole Stomach wet weight in grams

>ContentsWW\_g: Stomach contents (minus stomach lining), wet weight in grams

> Files: [D15] StomachFullness\_ROutput.csv

\*Same as above, but includes the following as additional columns:

>SL\_mm: Standard Length of fish in mm

>WholeBodyWW\_g: Whole body wet weight of fish in grams

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>StomachFullness: ContentsWW\_g/( WholeBodyWW\_g – ContentsWW\_g)

>sqrtFullness: square-root transformed stomach fullness

>**Fish Diet Composition**

>Files: [D7] PreyData\_Raw.csv

>Rows represent age-0 Pacific Cod. **Note:** most individuals are represented by multiple rows due to the number of unique prey items in their stomachs

>Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>PreySpecies: Unique prey species found in the stomachs of individual fish

>PreyCount: total number of each prey species found within an individual stomach

>PreyWW\_g: total wet weight in grams of each prey species found within an individual stomach

>PreyLH: prey life history stage

>Files: [D8] JulyPSIRI\_ROutput.csv

>Rows represent individual age-0 Pacific Cod

> Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>CLADOCERA: percent PSIRI (calculated using Main text Eq. 2) of cladocerans in each individual fish stomach

>MYSIDAE: percent PSIRI (calculated using Main text Eq. 2) of mysids in each individual fish stomach

>GAMMARIDAE: percent PSIRI (calculated using Main text Eq. 2) of gammarid amphipods in each individual fish stomach

>HARPACTICOIDA: percent PSIRI (calculated using Main text Eq. 2) of harpacticoid copepods in each individual fish stomach

>CAPRELLIDAE: percent PSIRI (calculated using Main text Eq. 2) of caprellid amphipods in each individual fish stomach

>CALANOIDA: percent PSIRI (calculated using Main text Eq. 2) of small calanoid copepods in each individual fish stomach

>OTHER: percent PSIRI (calculated using Main text Eq. 2) of all prey groups represented in fewer than 3.5% of all stomachs sampled for July across all years

>Files: [D13] JulyNMS\_ROutput.csv

\*Same as above, but includes the following as additional columns:

>NMDS1: Axis 1 of the July NMS Ordination

>NMDS2: Axis 2 of the July NMS Ordination

>NMDS3: Axis 3 of the July NMS Ordination

>SL\_mm: Standard Length of fish in mm

>WholeBodyWW\_g: Whole body wet weight of fish in grams

>HSI: Hepatosomatic Index

>LWResiduals\_All: Length-weight condition residuals based on a linear regression of logSL against logWeight for all fish across both months.

>SeineID: unique secondary key identifier for beach seines

> SITEID: unique secondary key identifier for sampling sites

>Date: Date associated with date of capture in year-month-day format

> TridentTemp: Daily temperature value in degrees Celsius

> Site: Site Name

> Bay: Anton Larsen Bay (ALB), Cook Bay (Cook), and Offshore. Offshore sites were excluded from this analysis. See Figures S6 for a sampling map of these bays.

>Habitat: Dominant submerged aquatic vegetation at the site

>Files: [D9] AugPSIRI\_ROutput.csv

>Rows represent individual age-0 Pacific Cod

> Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>CLADOCERA: percent PSIRI (calculated using Main text Eq. 2) of cladocerans in each individual fish stomach

>GAMMARIDAE: percent PSIRI (calculated using Main text Eq. 2) of gammarid amphipods in each individual fish stomach

>HARPACTICOIDA: percent PSIRI (calculated using Main text Eq. 2) of harpacticoid copepods in each individual fish stomach

>MYSIDAE: percent PSIRI (calculated using Main text Eq. 2) of mysids in each individual fish stomach

>CAPRELLIDAE: percent PSIRI (calculated using Main text Eq. 2) of caprellid amphipods in each individual fish stomach

>CALANOIDA: percent PSIRI (calculated using Main text Eq. 2) of small calanoid copepods in each individual fish stomach

>ANNELIDA: percent PSIRI (calculated using Main text Eq. 2) of annelid worms in each individual fish stomach

>OTHER: percent PSIRI (calculated using Main text Eq. 2) of all prey groups represented in fewer than 3.5% of all stomachs sampled for August across all years

>Files: [D14] AugNMS\_ROutput.csv

\*Same as above, but includes the following as additional columns:

>NMDS1: Axis 1 of the August NMS Ordination

>NMDS2: Axis 2 of the August NMS Ordination

>NMDS3: Axis 3 of the August NMS Ordination

>SL\_mm: Standard Length of fish in mm

>WholeBodyWW\_g: Whole body wet weight of fish in grams

>HSI: Hepatosomatic Index

>LWResiduals\_All: Length-weight condition residuals based on a linear regression of logSL against logWeight for all fish across both months.

>SeineID: unique secondary key identifier for beach seines

> SITEID: unique secondary key identifier for sampling sites

>Date: Date associated with date of capture in year-month-day format

> TridentTemp: Daily temperature value in degrees Celsius

> Site: Site Name

> Bay: Anton Larsen Bay (ALB), Cook Bay (Cook), and Offshore. Offshore sites were excluded from this analysis. See Figures S1 for a sampling map of these bays.

>Habitat: Dominant submerged aquatic vegetation at the site

>**Sampling Data**

> Files: [D10] SampingData\_Master.csv

>Rows represent individual fish

>Columns:

>FISHID: unique primary key identifier for individual fish

>SeineID: unique secondary key identifier for beach seines

>SITEID: unique secondary key identifier for sampling sites

>Year: Year fish was captured

>Month: Month fish was captured

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>**Fish Growth**

>Files: [D11] OtolithIncrements\_Raw.csv

>Rows represent age-0 Pacific Cod.

>Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>SL\_mm: Standard Length of fish in mm

>OtolithRadius\_Avg: Otolith Radius in mm from core to the edge on the proximal-distal axis

>Fil21d: Total distance in mm from edge to increment 21 days prior to capture

>increment21\_edge: Increment width in mm from 1 day prior to capture

>increment20: Increment width in mm from 2 days prior to capture

>increment19: Increment width in mm from 3 days prior to capture

>increment18: Increment width in mm from 4 days prior to capture

>increment17: Increment width in mm from 5 days prior to capture

>increment16: Increment width in mm from 6 days prior to capture

>increment15: Increment width in mm from 7 days prior to capture

>increment14: Increment width in mm from 8 days prior to capture

>increment13: Increment width in mm from 9 days prior to capture

>increment12: Increment width in mm from 10 days prior to capture

>increment11: Increment width in mm from 11 days prior to capture

>increment10: Increment width in mm from 12 days prior to capture

>increment9: Increment width in mm from 13 days prior to capture

>increment8: Increment width in mm from 14 days prior to capture

>increment7: Increment width in mm from 15 days prior to capture

>increment6: Increment width in mm from 16 days prior to capture

>increment5: Increment width in mm from 17 days prior to capture

>increment4: Increment width in mm from 18 days prior to capture

>increment3: Increment width in mm from 19 days prior to capture

>increment2: Increment width in mm from 20 days prior to capture

>increment1\_closertocore: Increment width in mm from 21 days prior to capture

>Files: [D12] BackCalculatedGrowth \_ROutput.csv

>Rows represent age-0 Pacific Cod.

>Columns:

>FISHID: unique primary key identifier for individual fish

>Year: Year associated with fish

> Month: Month associated with fish

>Heatwave: Categorical indicator for if the year was considered to occur before ("before"), during ("during"), or between marine heatwaves ("between"). See main text for details on how these categories were selected.

>SL\_mm: Standard Length of fish in mm

>OtolithRadius\_Avg: Otolith Radius in mm from core to the edge on the proximal-distal axis

>IncrementNumber: Otolith increment number, with 21 representing 1 day prior to capture and 1 representing 21 days prior to capture

>IncrementWidth: Width in mm of otolith increments

>rad-at-age: distance in mm from core to increment number on the otolith’s proximal-distal axis

>log\_sl\_capture: log-transformed standard length at capture

>log\_rad\_at\_age: log-transformed otolith radius at age

>log\_rad\_at\_capture: log-tranformed total otolith radius from core to edge

>Size\_Initial\_BIC: Standard length in mm for each day of the fish’s final 21 days of life using the Biological Intercept Back-Calculation (Eq. 3 Main Text)

>mm\_day\_BIC: Absolute growth rate in mm/day using the Size\_Initial\_BIC values

>mm\_mm\_day\_BIC: Relative growth rate in mm/mm/day using the Size\_Initial\_BIC values

>Files: [D16] Final21Days\_withDate.csv

>Rows represent age-0 Pacific Cod.

>Columns:

>FISHID: unique primary key identifier for individual fish

>Increment\_21Edge: Otolith increment number, with 21 representing 1 day prior to capture and 1 representing 21 days prior to capture

>Date: Date, in year-month-day format associated with each of the final 21 days of a fish’s life, determined using known date-at-capture