

Atlantic silverside (*Menidia menidia*) embryo mortality at different temperatures and exposure durations

Website: <https://www.bco-dmo.org/dataset/1010490>

Data Type: experimental

Version: 1

Version Date: 2026-10-26

Project

» [Collaborative Research: REU Site Mystic Aquarium: Plankton to Whales: Consequences of Global Change within Marine Ecosystems](#) (REU Plankton to Whales)

Contributors	Affiliation	Role
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Abstract

In two independent experiments, we reared newly fertilized Atlantic silverside (*Menidia menidia*) embryos produced from wild spawners collected at Mumford Cove, CT (eastern Long Island Sound) at 23 degrees Celsius (°C) to hatch. One half of the embryos (total >6800 per experiment) was exposed to 5 temperatures (Experiment 1: 27-34°C, Experiment 2: 34 - 41°C) after 19 hours post fertilization (hpf), while the other half was exposed to the same temperatures after 67hpf. Exposures lasted 5, 30, 60, 120, and 240 minutes, after which embryos were transferred back to the control tank. Dead embryos were counted 48 hours post exposure; in addition, live embryos and larvae were also counted on the day of hatching (7 days post fertilization, dpf). Dead or live embryos were counted with 5 replicates; hatched larvae were assessed on the treatment level (exp × temp × duration). Embryo mortality (%) was calculated as dead/fertilized embryos*100; in addition, we calculated an adjusted mortality that corrected for counting uncertainties.

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
 - [BCO-DMO Curation Notes](#)
- [Data Files](#)
- [Parameters](#)
- [Instruments](#)
- [Project Information](#)
- [Funding](#)

Coverage

Location: Mumford Cove, Eastern Long Island Sound, Northwest Atlantic shelf

Spatial Extent: Lat:41.323611 Lon:-72.018611

Temporal Extent: 2026-06-11 - 2026-07-03

Methods & Sampling

On 10 June (Exp1) and 24 June 2026 (Exp2), we caught spawning ripe Atlantic silversides (*Menidia menidia*) in a small nearby cove (Mumford Cove, CT), using a 33 × 2 meter (m) beachseine. The fish were transported live to the University of Connecticut's Rankin seawater lab and kept there in aerated tubs at ~21°C overnight. On 11 June (Exp1) and 25 June (Exp2) at 3 PM, we strip-spawned 28 females and 52 males (Exp1: 28 fem – 52 male; Exp2: 25 fem – 36 male) to produce ~ 15,000 embryos per experiment. Embryos were spawned onto plastic window screen (1-millimeter (mm) mesh), then screens were cut into small pieces where we counted the number of fertilized embryos (15 – 35). We did this 255 times for each experiment; 5 screens (replicates) for each of 5 exposure temperatures, 5 exposure durations, and 2 exposure time points = 5 × 5 × 5 × 2 = 250. 5

screens served as controls (no exposure). For temperature exposures, embryos were transferred from the control tank to glass aquaria equipped with temperature controllers and 800W aquarium heaters. Onset HOBO loggers were used to record temperatures at 5 minute intervals.

Data Processing Description

Embryo mortality (unadjusted): to calculate embryo mortality for each replicate, we used the dead embryo counts 48 hours post exposure and divided them by the number of fertilized embryos, as counted on the day of fertilization.

Embryo mortality (adjusted): In theory, the number of dead embryos plus the number of live embryos and hatched larvae at the end of each experiment should equal the number of counted fertilized embryos at the beginning of each experiment. In reality, there is counting uncertainty (think of enumerating 500× 20-40 1mm sized spheres with your naked eyes) and some uncertainty due to dead embryos potentially falling off the screen as they decay. Embryo checks post exposure were done under magnification (Nikon stereomicroscope ~8x) are therefore more accurate than the initial counting.

To quantify the inherent counting discrepancy, we first estimated the expected number of hatched larvae (N_{exp}) for each replicate (screen) based on the number of all hatched larvae counted per cup (N_{Larvae}) multiplied by the proportion of fertilized embryos for each replicate (N_{Fert}) to the sum of fertilized embryos over all 5 replicates per treatment ($S_{\text{Fert}_{R1-R5}}$). This is necessary because all larvae per treatment hatched into the same cup, so their relative allocation to each replicate needs to be estimated.

$$N_{\text{exp } ijklm} = N_{\text{Fert } ijklm} / (S_{jklm} (\text{Fert}_{R1-R5}) \times N_{\text{Larvae } jklm})$$

for the i^{th} replicate (1-5) of the j^{th} exposure temperature (26-42C) of the k^{th} exposure duration (5 – 240 min) of the l^{th} exposure time point (19 or 67 hpf) of the m^{th} experiment (1 or 2).

For each replicate, we then summed all dead embryos 48 post exposure, all live embryos at the day of hatch, and all estimated hatched larvae (N_{exp}). This number represented the embryos accounted for. We then subtracted the number of accounted for embryos from those fertilized to estimate the discrepancy. Overall, the mean $\pm$ SD discrepancy across both experiments was not significantly different from zero (-0.2 ± 5.2 embryos). Judging by the SD, our average uncertainty was ± 5 embryos.

Depending on whether the discrepancy was negative (more embryos accounted for than initially counted as fertilized) or positive (less embryos accounted for than initially counted as fertilized), we made the following adjustments:

- Negative discrepancy: we adjusted the number of fertilized embryos upwards, assuming that these screens were initially undercounted.
- Positive discrepancy: we adjusted the number of dead embryos upwards, assuming that some dead embryos likely fell off the screen and were therefore missed when checked 48 hours post exposure.

We then calculated the **adjusted embryo mortality (%)** per replicate by dividing the adjusted number of dead embryos 48 hours post exposure by the number of adjusted fertilized embryos * 100.

BCO-DMO Curation Notes

This section documents curation actions performed prior to publication review with the submitter, and additional information relevant to understanding and reusing this dataset. It distinguishes changes made to the submitted (meta)data from unresolved issues and/or enhancements that improve future reuse and interoperability.

CURATION ACTIONS PERFORMED ON DATA

- Imported sheet 2 of original file "Baumann_Menidia embryo source.xlsx" (xlsx) into the BCO-DMO data processing system.
- Treated "#VALUE!" as missing values (missing values are empty/blank in the final CSV file).

- Renamed columns to comply with BCO-DMO parameter naming conventions.
- Ran find/replace to strip non-space whitespace and invisible Unicode characters (e.g., non-breaking spaces, zero-width characters) from Exposure_date, Exposure_duration, Check_2_date_48h_post_exposure, Dead_embryos_48h_post_exposure, and Embryos_live_at_hatch.
- Converted Fertilization_date, Exposure_date, Check_2_date_48h_post_exposure, and Hatch_check_date_7_dpf from %m-%d-%y to date format %Y-%m-%d.
- Converted Fertilization_time from %H:%M %p to time format %H:%M.
- Saved the final file as "1010490_v1_menidia_embryo_thermal_tolerance.csv".

CURATION ACTIONS PERFORMED ON METADATA

- BCO-DMO's standard metadata entry and text formatting steps were performed. See: <https://www.bco-dmo.org/how-to/standard-curation-edits>

ISSUES POTENTIALLY IMPACTING REUSE

- N/A

[[table of contents](#) | [back to top](#)]

Data Files

File
1010490_v1_menidia_embryo_thermal_tolerance.csv (Comma Separated Values (.csv), 57.56 KB) MD5:e1ac837c94869541832cd655464437db Primary data file for dataset ID 1010490, version 1

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
Species	Atlantic silverside, Menidia menidia	unitless
Experiment	Either experiment 1 or experiment 2	unitless
Fertilization_date	Date offspring was fertilized	unitless
Fertilization_time	Time offspring was fertilized on date in EDT (UTC-4)	unitless
Exposure_date	Date embryos were exposed to heat stress	unitless
Exposure_start_hpf	Hours post fertilization (hpf) when exposure started, CT stands for 'Control' (no exposure)	hours
Exposure_temperature	Exposure temperature (240 min mean)	degrees Celsius
Exposure_duration	Duration of the heat exposure	minutes

Replicate	Replicate number (1 to 5)	unitless
Screen_ID	Unique screen ID, where attached embryos were counted	unitless
Fertilized_embryos	Number of counted embryos post fertilization	unitless
Fertilizedembryos_per_cup	Sum of all fertilized embryos per treatment (sum rep1 to 5)	unitless
Check_2_date_48h_post_exposure	Date embryos were checked for mortality (48h post exposure)	unitless
Dead_embryos_48h_post_exposure	Number of dead embryos	unitless
Hatch_check_date_7_dpf	Date of first major hatch, when experiment ended and all live embryos and hatched larvae were counted	unitless
Embryos_live_at_hatch	Embryos alive but not yet hatched	unitless
Hatched_Larvae_per_container	Number of hatched larvae per treatment (all screens comb)	unitless
Estimated_hatched_larvae	Estimated number of hatched larvae per replicate	unitless
Discrepancy	Fertilized - accounted for embryos (dead + live + hatched)	unitless
Fertilized_embryos_adj	Number of fertilized embryos (adjusted if discrepancy < 0)	unitless
Dead_embryos_adj	Number of dead embryos (adjusted if discrepancy > 0)	unitless
Embryo_mortality_unadj	Percent embryo mortality per replicate (Dead 48h/Fertilized*100)	unitless (percent)
Embryo_mortality_adj	Percent embryo mortality per replicate (adj dead 48h/adj fertilized *100)	unitless (percent)

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	800W aquarium heaters
Generic Instrument Name	Immersion heater
Generic Instrument Description	Submersible heating element for water tanks and aquaria.

Dataset-specific Instrument Name	Nikon stereomicroscope
Generic Instrument Name	Microscope - Optical
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	HOBO Onset temperature loggers
Generic Instrument Name	Temperature Logger
Generic Instrument Description	Records temperature data over a period of time.

Dataset-specific Instrument Name	Aqualogic temperature controllers
Generic Instrument Name	thermostat
Generic Instrument Description	A device designed to regulate temperature by controlling the starting and stopping of a heating/cooling system.

[[table of contents](#) | [back to top](#)]

Project Information

Collaborative Research: REU Site Mystic Aquarium: Plankton to Whales: Consequences of Global Change within Marine Ecosystems (REU Plankton to Whales)

NSF Award Abstract:

This REU Site award to Mystic Aquarium, located in Mystic, CT, will support the training of 30 students for 10 weeks during the summers of 2024-2026. Research is conducted at the University of Connecticut's (UConn) Avery Point campus, Groton, CT which currently hosts the Mystic Aquarium laboratories and collaborative partner UConn's Department of Marine Sciences. Research will focus on how marine organisms and their ecosystems are affected by global change, such as climate change. Professional Development activities and opportunities will occur at Mystic Aquarium. It is anticipated that students, primarily from schools with limited research opportunities, will be trained in the program. Students will learn how research is conducted, will present their findings for both scientific and public audiences and many will present the results of their work at scientific conferences. Assessment of this program will be done through an online tool. Students should apply to the REU site using NSF ETAP (Education and Training Application).

The REU program focuses on how global change affects marine animals and their ecosystems. Students will be mentored by Aquarium and UConn scientists that specialize in aquatic animal physiology, behavior, and ecological processes. Each student project will focus on a different trophic level in the marine ecosystem, with all students working together to address the overarching question of how changes in the environment can affect the marine ecosystem. Field trips to the Mystic Aquarium will be a major component of this immersive experience, including but not limited to educational tours, animal and ecosystem exhibit observations, job shadowing, ethics/responsible conduct of research, and a science communication workshop. Motivated students should apply on-line (<https://etap.nsf.gov>) and will be selected based on a personal statement of their interest in marine sciences, academic record, letters of recommendation, and brief explanation of desired research focus areas. Communication with prospective project mentors in advance is encouraged. More information and details about the program is available by contacting the PIs (Dr. Tracy Romano or Dr. Michael Finiguerra). This project is jointly funded by the Division of Biological Infrastructure in the Directorate of Biological Sciences, and Polar Special Programs in the Directorate of Geosciences.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

[[table of contents](#) | [back to top](#)]

Funding

Funding Source	Award
NSF Division of Biological Infrastructure (NSF DBI)	DBI-2349353

[[table of contents](#) | [back to top](#)]