Survival of northern sand lance Ammodytes dubius offspring under factorial CO2 x temperature conditions

Website: https://www.bco-dmo.org/dataset/749429
Data Type: experimental
Version: 2
Version Date: 2021-05-27

Project
» Sensitivity of larval and juvenile sand lance Ammodytes dubius on Stellwagen Bank to predicted ocean warming, acidification, and deoxygenation (OA Stellwagen Sand Lance)

Contributors	Affiliation	Role
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Murray, Christopher S.	University of Connecticut (UConn - Avery Point)	Co-Principal Investigator
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Abstract
Survival source data of 2016-2018 experimental work on the sensitivity of northern sand lance (A. dubius) offspring to combined ocean warming and acidification.

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Coverage

Spatial Extent: **Lat**:42.166183 **Lon**:-70.312275
Temporal Extent: 2016-12-02 - 2017-11-24

Dataset Description

Survival source data of 2016-2018 experimental work on the sensitivity of northern sand lance offspring to combined ocean warming and acidification.

Methods & Sampling

Spawning-ripe sand lance were collected from SBNMS (42° 9' 58.26" N, 70° 18' 44.19" W) on 2 December 2016 and 22 November 2017, using a 1.3 × 0.7 m beam trawl (6 mm mesh) towed at 3 knots for 15 minutes.

We tested factorial combinations of three pCO2 × three temperature levels. The target for pCO2 controls was

400 µatm (~8.15 pHNIST), a level characteristic of the average open ocean and of the *A. dubius* spawning habitat in late fall (Salisbury and Jönsson, 2018). As contrasts, we chose 1,000 µatm (~7.78 pH) and 2,100 µatm (~7.48 pH), which correspond to predicted average ocean pCO2 levels by the years 2100 and 2300, respectively.

Response traits: Treatment-specific embryo survival was calculated in trials 1 and 3 as the proportion of hatchlings relative to the number of fertilized embryos (%), while in trial 2 the total number of hatchlings was used as a proxy for embryo survival. In trial 3, fertilization success (%) was calculated as the sum of hatched larvae + arrested embryos divided by 300. Treatment-specific daily hatch frequencies (= daily treatment hatch/total hatch within temperature treatment) were calculated for trials 2 and 3.

Data Processing Description

Data processing: Data were cross-checked with hand-written notes, checked for outliers/erroneous entries/numbers.

BCO-DMO Data Processing:
- modified parameter names (replaced spaces with underscores, replaced "%" with "pcnt")
- converted latitude and longitude from degrees, minutes, seconds to decimal degrees
- reformatted date from mm/dd/yyyy to yyyy-mm-dd
- replaced "n/a" with "nd" (no data);
- replaced earlier copy of data (2018-11-07) with revised copy on 2019-09-20;
- version 2 published on 2021-05-27. This version contains corrections to the pcnt_hatching_success data values.

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Data Files

File	
sand_lance_survival.csv	(Comma Separated Values (.csv), 9.71 KB) MD5:183ac499cc8c2fc7ab4db5ea40893d61
Primary data file for dataset ID 749429	

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Related Publications

Murray, C. S., Wiley, D., & Baumann, H. (2019). High sensitivity of a keystone forage fish to elevated CO2 and temperature. Conservation Physiology, 7(1). doi:10.1093/conphys/coz084
Results

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Parameters

Parameter	Description	Units
trial	Trial number	unitless
species	Ammodytes dubius, the northern sand lance	unitless
adult_collection_site	Site of the collection of wild adult spawners	unitless
latitude	Latitude of adult collection site	decimal degrees
longitude	Longitude of adult collection site	decimal degrees
tank	Tank number	unitless
temperature	Average temperature experienced by fish in degrees celsius	degrees Celsius
replicate	Within experiment replicate number	unitless
pH	Average pH level experienced by the fish NBS	pH NBS
pCO2	Calculated average pCO2 levels in uatm calculated by CO2SYS based on alkalinity, pH, and temperature	uatm
fertilization_date	Date offspring were fertilized by stripspawning 10+ adults of each sex; format: yyyy-mm-dd	unitless
initial_embryo_count	The total starting number of embryos per replicate	unitless
total_hatch	The total number of larvae that hatched wihtin each replicate	unitless
pcnt_hatching_success	% survival of embryos from fertilization to hatch	unitless (percent)
pcnt_larval_survival	% survival of larvae from hatch to 150 degree days post-hatch	unitless (percent)
growth_rate	Average replicate growth rate (mm d-1) of offspring from hatch to experiment termination	millimeters per day(mm d-1)

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Instruments

Dataset-specific Instrument Name	beam trawl
Generic Instrument Name	Beam Trawl
Dataset-specific Description	Spawning-ripe sand lance were collected using a beam trawl.
Generic Instrument Description	A beam trawl consists of a cone-shaped body ending in a bag or codend, which retains the catch. In these trawls the horizontal opening of the net is provided by a beam, made of wood or metal, which is up to 12 m long. The vertical opening is provided by two hoop-like trawl shoes mostly made from steel. No hydrodynamic forces are needed to keep a beam trawl open. The beam trawl is normally towed on outriggers, one trawl on each side. While fishing for flatfish the beam trawl is often equipped with tickler chains to disturb the fish from the seabed. For operations on very rough fishing grounds they can be equipped with chain matrices. Chain matrices are rigged between the beam and the groundrope and prevent boulders/stones from being caught by the trawl. Shrimp beam trawls are not so heavy and have smaller mesh sizes. A bobbin of groundrope with rubber bobbins keeps the shrimp beam trawl in contact with the bottom and gives flatfish the opportunity to escape. Close bottom contact is necessary for successful operation. To avoid bycatch of most juvenile fishes selectivity devices are assembled (sieve nets, sorting grids, escape holes). While targeting flatfish the beam trawls are towed up to seven knots, therefore the gear is very heavy; the largest gears weighs up to 10 ton. The towing speed for shrimp is between 2.5 and 3 knots. (from: http://www.fao.org/fishery/geartype/305/en)

Dataset-specific Instrument Name	pH electrode
Generic Instrument Name	pH Sensor
Dataset-specific Description	pH electrode (Hach pHD, calibrated weekly using 2-point pHNIST references)
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

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Project Information

Sensitivity of larval and juvenile sand lance Ammodytes dubius on Stellwagen Bank to predicted ocean warming, acidification, and deoxygenation (OA Stellwagen Sand Lance)

Website: https://seagrant.unh.edu/project/research/sensitivity-larval-and-juvenile-sand-lance-ammodytes-dubius-stellwagen-bank

Coverage: Stellwagen Bank, southern Gulf of Maine

Objectives:
This proposal will quantify the sensitivity of a key forage fish in the Northwest Atlantic to the individual and combined effects of the major factors comprising the ocean climate change syndrome: warming, acidification,

and deoxygenation. We will rear embryos of Northern sand lance Ammodytes dubius, obtained by strip-spawning wild adults from the Stellwagen Bank National Marine Sanctuary (SBNMS) through larval and early juvenile stages in a purposebuilt factorial system at different factorial combinations of temperature × CO2 × oxygen.

Our first objective is to quantify individual and combined effects of temperature × CO2 (year 1) and temperature × CO2 × DO (year 2) on A. dubius growth and survival. We hypothesize that warming in combination with high CO2 (low pH) will have additive or synergistically negative effects, whereas the addition of low DO as a third stressor will have stark, synergistically negative effects on all traits.

Our second objective is to characterize the swimming behavior of A. dubius larvae that have been reared under combinations of elevated temperature × CO2. We hypothesize that combined stressors will have synergistically negative effects on the development of larval sensory systems, which express themselves and can thus be quantified as changes in larval swimming behavior.

Our third objective is to take advantage of the rare winter sampling activities for this project to quantify CO2, pH, and DO variability in benthic waters on Stellwagen Bank through bottle collections and short-term sensor deployments. We hypothesize that bottom water pH and DO levels during the sand lance spawning season might be routinely lower than levels in surface waters.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536165
New Hampshire Sea Grant (NHSG)	RNE16-CTHCE-I

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