Larval abundance data collected by plankton pump or diver-towed plankton nets at Bird Rock, La Jolla, CA, 2014-2016

Website: https://www.bco-dmo.org/dataset/743779
Data Type: Cruise Results
Version: 1
Version Date: 2018-08-20

Project
» Nearshore larval transport: physical and biological processes (Nearshore larval transport)
» RAPID: Nearshore settlement and hydrodynamics in Southern California during El Nino, and the transition to normal ocean conditions: boom and bust? (RAPID_Settlement_Hydrodynamics)

Contributors	Affiliation	Role
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Abstract
Abundances of barnacle and bryozoan larvae collected in the water column on multiple cruises at stations along the Southern California nearshore at depths 0-~14 m water depth and from offshore Calumet Park, La Jolla, Southern California, from 2014-05-09 to 2016-10-04.

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Coverage

Spatial Extent: **N**:32.81113 **E**:-117.2691 **S**:32.807 **W**:-117.2807
Temporal Extent: 2014-05-09 - 2016-10-04

Dataset Description

Abundances of barnacle and bryozoan larvae collected in the water column on multiple cruises at stations along the Southern California nearshore at depths 0-~14 m water depth and from offshore Calumet Park, La Jolla, Southern California, from 2014-05-09 to 2016-10-04.

Acquisition Description

Larvae were collected by either plankton pump (normal, event, thermo, and swell cruise types, or by divers towing a plankton net (diver). All samples have been standardized as larval concentration (# larvae/m^3). Larval plankton pump sampling and processing are as described in Hagerty, et al (2018).

Depths/stations sampled depended on cruise type and included:
- Normal cruise: Stations at 4m, 6m, 8m, 10m, 12m, and 14m depths, where the pump filtered water in 2m depth intervals from the surface to the bottom.

- Event cruise: Stations sampled between 8m and 3m depths depending on the location of warm temperature fronts. The pump filtered water at 0.15m, 0.75m, 2m, and 0.20 meters above bottom).

- Swell cruise: Sampling during high wave conditions, at 8m depth, with pump filtering water in 2m depth intervals from the surface to the bottom.

- Thermo cruise: Sampling at a fixed station at 5m depth, with pump filtering water in 1m depth intervals from the surface to the

bottom.

Larval plankton net sampling employed paired 120 µm mesh, 20.32cm diameter plankton nets equipped with mechanical flow meters (General Oceanics 2030R).

- Diver cruise: Divers pushed nets through the water at the surface, mid-depth, and near-bottom at stations located in 2m, 4m, and 8m depths.

Cruise area is Southern California nearshore, depths 0-~14 m water depth. The campling location was offshore Calumet Park, La Jolla, Southern California, USA within the box delimited by the following points:
NE 32° 48.677'N, 117° 16.195'W
SE 32° 48.568'N, 117° 16.145'W
SW 32° 48.421'N, 117° 16.738'W
NW 32° 48.619'N, 117° 16.842'W

Overall larval abundances for 2014-2016 normal cruises published in: Pineda, J., et al. (2018). See also 2014-2015 data in: Hagerty, M. L. (2017).

Processing Description

All processed data are average larval concentrations by date and cruise type.

BCO-DMO data manager processing notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- reduced number of digits to right of decimal from 14 to 3 places for all abundances
- re-formatted date from m/d/yyyy to yyyy-mm-dd

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Related Publications

Hagerty, M., Reyns, N., & Pineda, J. (2018). Constrained nearshore larval distributions and thermal stratification. Marine Ecology Progress Series, 595, 105–122. doi:10.3354/meps12561
Methods
Results

Pineda, J., Reyns, N., & Lentz, S. J. (2018). Reduced barnacle larval abundance and settlement in response to large-scale oceanic disturbances: Temporal patterns, nearshore thermal stratification, and potential mechanisms. Limnology and Oceanography. doi:10.1002/lno.10964
Results

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Parameters

Parameter	Description	Units
cruise_type	Five type of cruises in this study: Normal cruise: Stations at 4m, 6m, 8m, 10m, 12m, and 14m depths where pump filtered water in 2m depth intervals from the surface to the bottom. Event cruise: Stations sampled between 8m and 3m depths depending on location of warm temperature fronts. Pump filtered water at 0.15m, 0.75m, 2m, and 0.20 meters above bottom). Swell cruise: Sampling during high wave conditions, at 8m depth, with pump filtering water in 2m depth intervals from the surface to the bottom. Thermo cruise: Sampling at fixed station at 5m depth, with pump filtering water in 1m depth intervals from the surface to the bottom. Diver cruise: Divers pushed nets through the water at the surface, mid-depth, and near-bottom at stations located in 2m, 4m, and 8m depths.	unitless
Avg_nauplii_m3	average abundance of nauplii	number/meter^3 (#/m^3)
Avg_Chthamalus_fissus_cyprids_m3	average abundance of Chthamalus_fissus_cyprids	number/meter^3 (#/m^3)
Avg_Balanus_glandula_cyprids_m3	average abundance of Balanus_glandula_cyprids	number/meter^3 (#/m^3)
Avg_Balanus_trigonus_cyprids_m3	average abundance of Balanus_trigonus_cyprids	number/meter^3 (#/m^3)
Avg_Megabalanus_rosa_cyprids_m3	average abundance of Megabalanus_rosa_cyprids	number/meter^3 (#/m^3)
Avg_Pollicipes_polymerus_cyprids_m3	average abundance of Pollicipes_polymerus_cyprids	number/meter^3 (#/m^3)
Avg_Tetraclita_rubescens_cyprids_m3	average abundance of Tetraclita_rubescens_cyprids	number/meter^3 (#/m^3)
Avg_zoeae_m3	average abundance of zoeae	number/meter^3 (#/m^3)
Avg_cyphonautes_m3	average abundance of cyphonautes	number/meter^3 (#/m^3)
Date	Sample collection date.	unitless

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Instruments

Dataset-specific Instrument Name	Larval plankton nets
Generic Instrument Name	Plankton Net
Dataset-specific Description	120 µm mesh, 20.32cm diameter equipped with mechanical flow meters (General Oceanics 2030R)
Generic Instrument Description	A Plankton Net is a generic term for a sampling net that is used to collect plankton. It is used only when detailed instrument documentation is not available.

Dataset-specific Instrument Name	Ebara 50DWXU6.4S Dominator submersible semivortex pump
Generic Instrument Name	Pump
Dataset-specific Description	Used to collect plankton samples for abundance measurements. Seawater was filtered through a 118 µm mesh net to capture barnacle larval stages.
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

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Deployments

Reyns_RAPID_2016

Website	https://www.bco-dmo.org/deployment/687011
Platform	R/V Gaia
Start Date	2016-04-22
End Date	2016-10-04

Pineda_small_boat

Website	https://www.bco-dmo.org/deployment/542994
Platform	R/V Gaia
Report	http://dmoserv3.whoi.edu/data_docs/Nearshore_Larval_Transport/sampling_report_nearshore_transport_spring2014.pdf
Start Date	2014-04-18
End Date	2015-11-20
Description	Series of nearshore and intertidal cruises during Spring 2014 and continuing in 2015. R/V Gaia is a University of San Diego vessel (a 7 m Parker, with outboard motor). Description of deployment events: 18 April 2014: deployed subsurface temperature mooring in 8m; deployed ADCP with temperature logger and Seaguage in 8m. Deployed two temperature loggers in intertidal under rocks with settlement plates. 21 April 2014: deployed temperature telemetry mooring in 8m. 23 April 2014: deployed 12 settlement plates in intertidal (checked daily). 1 May: deployed temperature loggers in 0.5m and 1m within intertidal. 2 May: deployed bottom frame in 4m with Nortek, temperature logger, and Seaguage. Plankton cruises: 5/9/2014; 5/14/2014; 5/23/2014; 5/26/2014; 6/3/2014; 6/4/2014; 6/6/2014; 6/11/2014; 6/15/2014; 6/16/2014; 6/17/2014; 6/25/2014; 6/27/2024; 7/2/2014; 7/7/2014; 7/11/2014; 7/14/2014. Recovery events: Recovered telemetry mooring and 4m frame on 15 July 2014. Recovered subsurface temperature mooring and ADCP from 8m on 16 July 2014. Recovered instruments and settlement plates from rocky intertidal 16 July 2014. Refer to the proposed spring 2014 sampling plan (PDF), spring 2015 sampling report (PDF), fall-2014/spring-2015/fall-2015 sampling plan (PDF).

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Project Information

Nearshore larval transport: physical and biological processes (Nearshore larval transport)

Coverage: Southern California

Description from NSF award abstract: Providing an award for this study will provide essential knowledge required for management of coastal resources. This study addresses near shore cross-shore larval transport processes that operate over wide geographic areas in open coast settings, namely larval transport by wave circulation / Stokes drift, and by internal tidal bores. Larval transport by wave circulation / Stokes drift is a ubiquitous process that has not been studied observationally, and it is not known how internal tidal bores deliver larvae to intertidal habitats. This project will examine near shore (region between 20 m depth and intertidal) physical and biological processes that account for the delivery of larvae to adult habitats. The study system in Southern California shares similarities with most other temperate areas and we will study marine taxa that are widely distributed and successful in a variety of environments. Recent studies suggest that larval transport in the near shore zone plays a central role in larval dispersal and connectivity of shallow water species. These recent advances, however, have not been matched with process-oriented studies addressing circulation and behavioral processes at the appropriate temporal and spatial scales, and only a few larval transport mechanisms have been considered for near shore open coastlines. Recent advances in our understanding of hydrodynamic processes driving cross-shore flows and growing awareness of the importance of the processes to larval transport, however, make this study timely. The investigators hypothesize that a series of physical and biological events results in the delivery of invertebrate larvae to the intertidal habitat. These events include physical transport due to wave circulation / Stokes drift near the surface and internal tide circulation near the bottom, alteration of behavior for terminal larval stages, and larval use of "adaptive" behavioral responses to exploit event-dependent flows. Further, they suggest that the predominance of wave circulation / Stokes drift and internal tide circulation varies seasonally, with internal tidal bores important in spring/summer, when the water column is well-stratified, and wave circulation / Stokes drift more pervasive in fall/winter, coinciding with winter storms. The hypotheses in this study will be tested with estimates of physical transport, larval supply and settlement. These measurements will be combined with use of adaptive sampling to test the dependence of larval vertical distribution on changes in hydrodynamic conditions. Results from this study will have important ecological implications as wave circulation / Stokes drift and internal motions may represent critical and regular transport mechanisms for larvae of marine organisms that must return to near shore habitats to complete their life cycle, thereby impacting population connectivity and management strategies used by coastal planners (e.g., ecosystem-based fisheries

management, placement of Marine Protected Areas).

RAPID: Nearshore settlement and hydrodynamics in Southern California during El Nino, and the transition to normal ocean conditions: boom and bust? (RAPID_Settlement_Hydrodynamics)

Coverage: Southern California

NSF Award Abstract: Understanding how larvae are transported in the coastal ocean is key for characterizing the population fluctuations of marine organisms. Studies demonstrate that larvae of species that inhabit shallow waters can behaviorally respond to changing oceanographic conditions by moving vertically into currents that can promote their transport to coastal, nearshore habitats where they settle to bottom habitats and complete their life cycle. However, the oceanographic mechanisms that promote such transport, and how they might be impacted by infrequent events such as El Niño, are poorly resolved. Given that El Niño events might increase in frequency and magnitude under climate change, it is imperative to assess how El Niño affects larval transport and larval settlement. To this end, this study will use an unprecedented set of nearshore biological and physical measurements spanning pre-El-Niño, during El Niño, and the predicted return to El Niño neutral conditions, to test mechanistically how larval transport and settlement respond in a nearshore coastal environment. This project will also provide educational and research opportunities for students at the University of San Diego, a liberal arts university. At least one laboratory exercise demonstrating the impacts of El Niño on larval transport and settlement will be developed for undergraduate students, and students will be recruited to participate in all aspects of the project to provide them with hands-on research experience. This research will form the basis for the thesis work of at least one M.S. graduate student. Finally, given that the research falls within a Marine Protected Area, results will be broadly disseminated and shared with coastal managers and the CA Department of Fish and Wildlife. Larval transport and settlement are fundamental processes for understanding the population dynamics of benthic invertebrates. Previous studies and unpublished observations indicate that El Niño events profoundly impact community and population processes, and in Southern California, El Niño effects range from alteration of larval transport and settlement of local populations, to the geographic expansion of subtropical species. This research will test the hypothesis that the current (2015-2016) El Niño event will result in a reduction of barnacle larval transport and settlement in Southern California nearshore habitats. Two mechanisms might be involved; first, a deepening of the thermocline forced by El Niño would result in reduction of larval transport by internal tidal bores, a mechanism that requires shallowing of the thermocline. Second, the distribution of larvae of littoral barnacles would be deeper, more offshore, and less constrained to nearshore habitats during El Niño than in El Niño neutral conditions, resulting in a reduction of nearshore larval abundance and settlement. The effects of El Niño on nearshore circulation, hydrography, larval transport and settlement in Bird Rock, Southern California, will be measured by a) deploying an array of instrumentation to measure temperature, pressure (waves) and currents; b) measuring daily barnacle larval settlement, and; c) assessing cross-shore and depth distribution of invertebrate larvae. These observations will be contrasted with two years of comparable observations taken at Bird Rock in 2014 (El Niño neutral conditions) and 2015 (during El Niño). Additionally, the investigators will measure weekly settlement at Bird Rock, and at Dike Rock, a site 7 km to the north, where previous observations at the end of the 1997/1998 El Niño indicated that barnacle settlement was very high. This will enable the evaluation of the generality of the settlement response as El Niño conditions eclipse, and examination of how settlement varies along a coastline.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1357290
NSF Division of Ocean Sciences (NSF OCE)	OCE-1357327
NSF Division of Ocean Sciences (NSF OCE)	OCE-1630474
NSF Division of Ocean Sciences (NSF OCE)	OCE-1630459

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