Time series of avg daily zooplankton concentration in the surf zone at Carmel River State Beach, Carmel Bay California in 2011 (Surf zone larval transport project)

Website: https://www.bco-dmo.org/dataset/563440
Version: 29 July 2015
Version Date: 2015-07-29

Project
» Does coupling between the inner shelf and surf zone regulate larval supply to intertidal populations? (Surf zone larval transport)

Contributors	Affiliation	Role
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Dataset Description

Time series of average daily zooplankton concentration in the surf zone at Carmel River State Beach, CA (36.53833 degrees N, 121.92861 degrees W).

Related references:

Shanks, A.L., S. G. Morgan, J. MacMahan, Ad J.H.M Reniers, M. Jarvis, J. Brown, and C. Griesemer (2014). Onshore transport of plankton by internal tides and upwelling-relaxation events. Marine Ecology Progress Series. DOI:10.3354/meps10717

Shanks, A.L., S. G. Morgan, J. MacMahan, Ad J.H.M Reniers, M. Jarvis, J. Brown, and C. Griesemer (2015). Transport of Larvae and Detritus Across the Surf Zone of a Steep Reflective Pocket Beach. Marine Ecology Progress Series. DOI:10.3354/meps11223

Methods & Sampling

In the surf zone, zooplankton samples were collected with a pump system. A 6 cm diameter hose was attached to pipes jetted into the sand and the pipes extended into the surf zone. A gas-powered pump sampled about 240 L of water per min, and 1.2 m^3 of seawater was filtered for each of three replicate samples per day. Samples were collected within one hour of high tide each day and were filtered through a 200

um mesh net. Depending on the wave height on a given day these samples were collected within the breakers or just a few meters seaward of the breakers. All samples were preserved in buffered formalin. Zooplankton in the samples was enumerated using dissecting microscopes.

Data Processing Description

Three samples were collected each day. Counts from the microscopic analysis of the samples were converted to number per m^3 and the average and 95% confidence interval for each daily set of samples were calculated. Note that blanks in the data set represent missing data values (BCO-DMO has changed blanks to 'nd'.)

BCO-DMO Processing:
- Re-formatted date, and added separate columns for month, day, year, and year-day.
- Added column containing site name.
- Added lat and lon (from metadata form).
- Modified parameter names to conform with BCO-DMO naming conventions.
- Replaced blanks (missing data) with 'nd' to indicate 'no data'.

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Data Files

File
CarmelRiver_SurfZone_Zoo2011.csv (Comma Separated Values (.csv), 8.02 KB) MD5:00f45c3e68577cd20d3d0fe73c678af7 Primary data file for dataset ID 563440

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Parameters

Parameter	Description	Units
site_name	Name of the sampling site.	text
lat	Latitude of the sampling site.	decimal degrees
lon	Longitude of the sampling site.	decimal degrees
date	Month/day/year of sample collection.	mm/dd/yyyy
Copepod	Copepod ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Copepod_95CI	Copepod 95% confidence interval.	number per cubic meter (#/m^3)
Copepod_nauplii	Copepod Nauplii ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)

Copepod_nauplii_95CI	Copepod Nauplii 95% confidence interval.	number per cubic meter (#/m^3)
Harpacticoid	Harpacticoid ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Harpacticoid_95CI	Harpacticoid 95% confidence interval.	number per cubic meter (#/m^3)
Larvacean	Larvacean ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Larvacean_95CI	Larvacean 95% confidence interval.	number per cubic meter (#/m^3)
Cladoceran	Cladoceran ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Cladoceran_95CI	Cladoceran 95% confidence interval.	number per cubic meter (#/m^3)
Mysid	Mysid ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Mysid_95CI	Mysid 95% confidence interval.	number per cubic meter (#/m^3)
Amphipod	Amphipod ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Amphipod_95CI	Amphipod 95% confidence interval.	number per cubic meter (#/m^3)
Ctenophore	Ctenophore ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Ctenophore_95CI	Ctenophore 95% confidence interval.	number per cubic meter (#/m^3)
Hydromedusii	Hydromedusii ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Hydromedusii_95CI	Hydromedusii 95% confidence interval.	number per cubic meter (#/m^3)
Barnacle_stg_I_III	Barnacle stage I-III ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Barnacle_stg_I_III_95CI	Barnacle stage I-III 95% confidence interval.	number per cubic meter (#/m^3)

Barnacle_stg_IV_VI	Barnacle stage IV-VI ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Barnacle_stg_IV_VI_95CI	Barnacle stage IV-VI 95% confidence interval.	number per cubic meter (#/m^3)
Cyprid	Cyprid ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Cyprid_95CI	Cyprid 95% confidence interval.	number per cubic meter (#/m^3)
Grapsid_zoea_I_III	Grapsid zoea stage I-III ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Grapsid_zoea_I_III_95CI	Grapsid zoea stage I-III 95% confidence interval.	number per cubic meter (#/m^3)
Grapsid_zoea_IV_V	Grapsid zoea stage IV-V ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Grapsid_zoea_IV_V_95CI	Grapsid zoea stage IV-V 95% confidence interval.	number per cubic meter (#/m^3)
Grapsid_megalopa	Grapsid megalopa ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Grapsid_megalopa_95CI	Grapsid megalopa 95% confidence interval.	number per cubic meter (#/m^3)
Cancer_zoea_I_III	Cancer zoea stage I-III ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Cancer_zoea_I_III_95CI	Cancer zoea stage I-III 95% confidence interval.	number per cubic meter (#/m^3)
Cancer_zoea_IV_V	Cancer zoea stage IV-V ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Cancer_zoea_IV_V_95CI	Cancer zoea stage IV-V 95% confidence interval.	number per cubic meter (#/m^3)
Cancer_megalopa	Cancer megalopa ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Cancer_megalopa_95CI	Cancer megalopa 95% confidence interval.	number per cubic meter (#/m^3)
Pinnotherid_zoea_I_III	Pinnotherid zoea stage I-III ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)

Pinnotherid_zoea_I_III_95CI	Pinnotherid zoea stage I-III 95% confidence interval.	number per cubic meter (#/m^3)
Pinnotherid_zoea_IV_V	Pinnotherid zoea stage IV-V ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Pinnotherid_zoea_IV_V_95CI	Pinnotherid zoea stage IV-V 95% confidence interval.	number per cubic meter (#/m^3)
Pinnotherid_megalopa	Pinnotherid megalopa ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Pinnotherid_megalopa_95CI	Pinnotherid megalopa 95% confidence interval.	number per cubic meter (#/m^3)
Majid_zoea_I_II	Majid zoea stage I-II ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Majid_zoea_I_II_95CI	Majid zoea stage I-II 95% confidence interval.	number per cubic meter (#/m^3)
Majid_megalopa	Majid megalopa ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Majid_megalopa_95CI	Majid megalopa 95% confidence interval.	number per cubic meter (#/m^3)
Porcellanid_zoea_I_II	Porcellanid zoea stage I-II ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Porcellanid_zoea_I_II_95CI	Porcellanid zoea stage I-II 95% confidence interval.	number per cubic meter (#/m^3)
Porcellanid_megalopa	Porcellanid megalopa ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Porcellanid_megalopa_95CI	Porcellanid megalopa 95% confidence interval.	number per cubic meter (#/m^3)
Emerita_stg_I	Emerita stage I ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Emerita_stg_I_95CI	Emerita stage I 95% confidence interval.	number per cubic meter (#/m^3)
Bivalves_veligers	Bivalves Veligers ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Bivalves_veligers_95CI	Bivalves Veligers 95% confidence interval.	number per cubic meter (#/m^3)

Gastropod_veligers	Gastropod Veligers ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Gastropod_veligers_95CI	Gastropod Veligers 95% confidence interval.	number per cubic meter (#/m^3)
Spionid_poly_larvae	Spionid Poly Larvae ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Spionid_poly_larvae_95CI	Spionid Poly Larvae 95% confidence interval.	number per cubic meter (#/m^3)
Other_polychaete_larvae	Other Polychaete larvae ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Other_polychaete_larvae_95CI	Other Polychaete larvae 95% confidence interval.	number per cubic meter (#/m^3)
Urchin_larvae	Urchin larvae ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Urchin_larvae_95CI	Urchin larvae 95% confidence interval.	number per cubic meter (#/m^3)
cyphonautes	Cyphonautes ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
cyphonautes_95CI	Cyphonautes 95% confidence interval.	number per cubic meter (#/m^3)
Bopalid_isopod_larvae	Bopalid isopod larvae ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
Bopalid_isopod_larvae_95CI	Bopalid isopod larvae 95% confidence interval.	number per cubic meter (#/m^3)
terrestrial_bugs	Terrestrial bugs ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
terrestrial_bugs_95CI	Terrestrial bugs 95% confidence interval.	number per cubic meter (#/m^3)
doliolids	Doliolids ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
doliolids_95CI	Doliolids 95% confidence interval.	number per cubic meter (#/m^3)

detritus	Detritus ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
detritus_95CI	Detritus 95% confidence interval.	number per cubic meter (#/m^3)
euphasid_larvae	Euphasid larvae ave #/m^3 (mean of the 3 replicate samples).	number per cubic meter (#/m^3)
euphasid_larvae_95CI	Euphasid larvae 95% confidence interval.	number per cubic meter (#/m^3)
mon	2-digit month of year.	mm (01 to 12)
day	2-digit day of month.	dd (01 to 31)
year	4-digit year.	YYYY
yrday	Consecutive day of year (Jan 1st = 1)	dimensionless

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Deployments

CRSB_2011

Website	https://www.bco-dmo.org/deployment/561647
Platform	Carmel_River_State_Beach
Start Date	2011-06-19
End Date	2011-07-15

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Project Information

Does coupling between the inner shelf and surf zone regulate larval supply to intertidal populations? (Surf zone larval transport)

Coverage: Sand City Beach and Carmel River State Beach, Monterey Bay, CA

Description from NSF award abstract:
Many intertidal invertebrates and fishes have complex life cycles that include a planktonic larval phase. At the end of their pelagic development, larvae must return to shore and cross the surf zone. The purpose of this study is to investigate for the first time the role of surf zone hydrodynamics in the rate of delivery of cyprids of intertidal barnacles to the shore. To exploit the greater physical oceanographic understanding of the hydrodynamics of sandy beach surf zones, this initial study will focus on cyprid settlement on hard substrates in surf zones associated with sandy beaches. In the first two years of the study, the investigators will carry out

an intensive two-month physical and biological study of a reflective and dissipative surf zone, respectively. At each site they will sample cyprids in the waters of the inner-shelf, just outside the surf zone, and within the surf zone and they will measure settlement on plates in the intertidal zone. At the same time they will collect physical oceanographic data with both in-situ instruments and a fleet of GPS-equipped surface drifters to describe the hydrodynamics of the surf zone. The time series of the physical and biological data will be correlated to investigate mechanisms of delivery of cyprids to the shore. To simulate the hydrodynamic processes responsible for the transport of larvae, the investigators will use a 3D model, resolving both the horizontal and vertical structure of the unsteady nearshore flow. To evaluate potential transport of larvae through the surf zone, a biological module describing the spatial distribution of the larvae will be coupled to the hydrodynamic module to predict the pathways of the larvae and compare with observations. Intensive sampling will help provide insight into the actual processes transporting cyprids from the inner shelf, through the surf zone, and to the intertidal zone. During each summer, weekly barnacle recruitment and daily cyprid settlement will be measured for two months to settlement plates at reflective and dissipative beaches in central California and southern Oregon. Population densities at many beaches along the West Coast will be surveyed each year to determine if a latitudinal gradient in wave energy is correlated with adult barnacle population densities.

Because the fundamentals of surfzone dynamics are universal, results of this research will be broadly applicable not only along the West Coast, but worldwide. This project will have significant impacts on education and public outreach. It will support three graduate students and nine undergraduate students and will create new research opportunities for students of diverse backgrounds from three undergraduate institutions, local high schools and the public. The research will be included in the curriculum of intensive hands-on courses, and undergraduates will participate in the research while learning how a real-world research project addresses fundamental questions. Both a website that highlights findings and an interactive display for visitors to the Bodega Marine Laboratory will be developed. A model coupling nearshore hydrodynamics and onshore transport across the surf zone will be made available to the community to stimulate research into this emerging research topic.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0926923

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