Phytoplankton growth rates and microzooplankton grazing from R/V Alpha Helix HX242, HX244, HX247, HX271, HX275 in the Northeast Pacific from 2001-2003

Website: https://www.bco-dmo.org/dataset/2475

Data Type: Cruise Results

Version: 1

Version Date: 2007-03-28

Project

» U.S. GLOBEC Northeast Pacific (NEP)

Program

» U.S. GLOBal ocean ECosystems dynamics (U.S. GLOBEC)

Contributors	Affiliation	Role
Strom, Suzanne	Western Washington University (WWU)	Principal Investigator
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Abstract

Phytoplankton growth rates and microzooplankton grazing from R/V Alpha Helix HX242, HX244, HX247, HX271, HX275 in the Northeast Pacific from 2001-2003

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Coverage

Spatial Extent: **N**:60.535 **E**:-146.607 **S**:58.097 **W**:-150.419

Temporal Extent: 2001-04-17 - 2003-08-09

Dataset Description

Phytoplankton Growth Rates in the coastal Gulf of Alaska

Phytoplankton growth rates, the phytoplankton growth rate response to nutrient enrichment, and microzooplankton grazing rates on phytoplankton in three different size classes were measured during three cruises to the coastal Gulf of Alaska in 2001.

Acquisition Description

[excerpted from Strom, et al. (2006) Microzooplankton grazing in the coastal Gulf of Alaska: Variations in top-down control of phytoplankton. Limnol Oceanogr in press.]

Water drawn from multiple Niskin bottles closed at a single depth was pooled into two 25-liter polycarbonate carboys. Most often, water was collected from the depth corresponding to 50% of surface irradiance (50% Io, 3 to 10 m). Once during April, and once per station during July, water was collected from the depth of the subsurface chlorophyll maximum (SCM, 12 to 25 m). The contents of one carboy were gravity-filtered (0.2 um) to generate particle-free filtered seawater (FSW, the diluent for the dilution series). The contents of the other were gently pre-screened through 200 um Nitex mesh to exclude macrozooplankton (WSW, the whole seawater for the dilution series). Using gentle siphoning and mixing techniques, FSW and WSW were combined in known proportions in 2.35-liter polycarbonate bottles to generate a dilution series consisting of 9, 16, 24, 41, 61, and 100% WSW (each in duplicate). An additional pair of bottles diluted to 4% was added during the May and July cruises, as well as an additional pair of 100% WSW bottles to control for the effects of nutrient enrichment on phytoplankton growth rate. Clean techniques and inert materials (silicone, polycarbonate) were used throughout.

Processing Description

Initial samples for size-fractionated chlorophyll (<5, 5 to 20, and >20 um, in quadruplicate), nutrients (nitrate, nitrite, silicic acid, phosphate), and microzooplankton abundance and composition (in duplicate, see below) were taken from the WSW carboy at intervals during experiment set-up. Initial chlorophyll levels in diluted bottles were calculated from these measured WSW values and known dilution factors. Coefficients of variation for quadruplicate initial chlorophyll samples averaged 7.9%, 13.5%, and 8.9% for the <5, 5 to 20, and >20 um size fractions, respectively. During May (all but outer shelf experiments) and July cruises, all diluted bottles and two 100% WSW bottles were enriched with nitrate (4.7 umol L-1 as NaNO3) and phosphate (0.27 umol L-1 as Na2HPO4). The other two 100% WSW bottles were left unenriched. Bottles were screened to collection-depth light levels with neutral density screening and incubated on deck in seawater-cooled incubators for 24 hr. All bottles were then sampled in duplicate for size-fractionated chlorophyll (filtration volumes ranged from 0.15 to 1.08 liter depending on WSW chlorophyll and dilution levels); 100% WSW bottles were additionally sampled for microzooplankton abundance and composition.

Net growth rates (k, d-1) for total chlorophyll and individual chlorophyll size fractions were calculated as (1/t)(ln[Pt/Po]), where Pt = final chlorophyll concentration, Po = initial chlorophyll concentration, and t = incubation time in d. Intrinsic growth rates (Âµ,d-1) of phytoplankton were estimated from the y-intercept of net growth rates regressed upon fraction WSW. For experiments exhibiting saturated grazing (i.e. a leveling of net growth rate across the least-dilute bottles) (Gallegos 1989), instrinsic growth rate estimates were based on regression of net growth rates in only the most dilute bottles (generally those with <40% WSW). Microzooplankton grazing rates (g, d-1) were estimated from the slope of the regression for experiments with linear relationships between net growth and fraction WSW, and as $g = Âμ_n - k_n$ (where k_n = net growth rate of phytoplankton in enriched, 100% WSW bottles) for experiments with saturated grazing. In experiments with nutrient enrichment, unenriched phytoplankton growth rates ($Âμ_o$) were calculated as $Âμ_o = k_o + g$, where k_o = net growth rate of phytoplankton in unenriched, 100% WSW bottles. Estimates of $Âμ_o$ were used to compare microzooplankton grazing to phytoplankton growth in situ ($g : Âμ_o$). These ratios represent the fraction of primary production consumed each day by microzooplankton grazing. Ratios were arctan transformed for estimation of means and standard deviations.

More detailed methods reference inÂ Strom, *et al.* (2006).

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Related Publications

Strom, S., Olson, M., Macri, E., & Mord, C. (2006). Cross-shelf gradients in phytoplankton community structure, nutrient utilization, and growth rate in the coastal Gulf of Alaska. Marine Ecology Progress Series, 328, 75â€“92. doi:10.3354/meps328075

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Parameters

Parameter	Description	Units
cruiseid	Cruise ID.	text
expt	Experiment number.	dimensionless
date_local	Day-month-year.	dd-mon-yy
station_std	standard station number	dimensionless
lat	Latitude	decimal degrees (North is positive)
lon	Longitude	decimal degrees (East is positive)
time_start_local	experiment start time	24-hour clock
depth	water collection depth	meters
chla_start_gt20um	initial chlorophyll concentration for dilutions experiments	micrograms/liter
chla_start_5_to_20um	initial chlorophyll concentration for dilutions experiments	micrograms/liter
chla_start_lt5um	initial chlorophyll concentration for dilutions experiments	micrograms/liter
chla_start_total	sum of three size fractions	micrograms/liter

fed_phyto_growth_gt20um	enriched (addition of nitrate and phosphate) phytoplankton growth rate	per day
fed_phyto_growth_5_to_20um	enriched (addition of nitrate and phosphate) phytoplankton growth rate	per day
fed_phyto_growth_lt5um	enriched (addition of nitrate and phosphate) phytoplankton growth rate	per day
fed_phyto_growth_total	sum of three size fractions	per day
fed_phyto_growth_std_err_gt20um	enriched phytoplankton growth rate standard error	per day
fed_phyto_growth_std_err_5_to_20um	enriched phytoplankton growth rate standard error	per day
fed_phyto_growth_std_err_lt5um	enriched phytoplankton growth rate standard error	per day
fed_phyto_growth_std_err_total	total standard error	per day
unfed_phyto_growth_gt20um	unenriched phytoplankton growth rate	per day
unfed_phyto_growth_5_to_20um	unenriched phytoplankton growth rate	per day
unfed_phyto_growth_lt5um	unenriched phytoplankton growth rate	per day
unfed_phyto_growth_total	sum of three size fractions	per day
unfed_phyto_growth_std_err_gt20um	unenriched phytoplankton growth rate standard error	per day
unfed_phyto_growth_std_err_5_to_20um	unenriched phytoplankton growth rate standard error	per day
unfed_phyto_growth_std_err_lt5um	unenriched phytoplankton growth rate standard error	per day
unfed_phyto_growth_std_err_total	total standard error	per day
microzoo_graz_gt20um	microzooplankton grazing rate for >20Âµ size fraction	per day

microzoo_graz_5_to_20um	microzooplankton grazing rate for >5 and	per day
microzoo_graz_lt5um	microzooplankton grazing rate for	per day
microzoo_graz_total	total microzooplankton grazing rate for all size fractions	per day
microzoo_graz_std_err_gt20um	standard error	per day
microzoo_graz_std_err_5_to_20um	standard error	per day
microzoo_graz_std_err_lt5um	standard error	per day
microzoo_graz_std_err_total	total standard error	per day
temp	temperature at sample depth	degrees Celsius
sal	dalinity at sample depth	Practical Salinity Units (PSU)
irradiance_mol_per_m2	irradiance at sample depth	mol photons/meter^2(per second?)

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Instruments

Dataset-specific Instrument Name	Niskin Bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Niskin bottle cast, use Bottle_Niskin
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24 or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

HX242

Website	https://www.bco-dmo.org/deployment/57523
Platform	R/V Alpha Helix
Report	http://globec.whoi.edu/nep/reports/cgoa_cruises/hx242cr.pdf

Start Date	2001-04-17
End Date	2001-05-01
Description	Original cruise data are available from the NSF R2R data catalog **Acquisition Description** [excerpted from Strom, et al. (2006) Microzooplankton grazing in the coastal Gulf of Alaska: Variations in top-down control of phytoplankton. Limnol Oceanogr in press.] Water drawn from multiple Niskin bottles closed at a single depth was pooled into two 25-liter polycarbonate carboys. Most often, water was collected from the depth corresponding to 50% of surface irradiance (50% Io, 3 to 10 m). Once during April, and once per station during July, water was collected from the depth of the subsurface chlorophyll maximum (SCM, 12 to 25 m). The contents of one carboy were gravity-filtered (0.2 Âµm) to generate particle-free filtered seawater (FSW, the diluent for the dilution series). The contents of the other were gently pre-screened through 200 Âµm Nitex mesh to exclude macrozooplankton (WSW, the whole seawater for the dilution series). Using gentle siphoning and mixing techniques, FSW and WSW were combined in known proportions in 2.35-liter polycarbonate bottles to generate a dilution series consisting of 9, 16, 24, 41, 61, and 100% WSW (each in duplicate). An additional pair of bottles diluted to 4% was added during the May and July cruises, as well as an additional pair of 100% WSW bottles to control for the effects of nutrient enrichment on phytoplankton growth rate. Clean techniques and inert materials (silicone, polycarbonate) were used throughout. **Processing Description** Initial samples for size-fractionated chlorophyll (20 Âµm, in quadruplicate), nutrients (nitrate, nitrite, silicic acid, phosphate), and microzooplankton abundance and composition (in duplicate, see below) were taken from the WSW carboy at intervals during experiment set-up. Initial chlorophyll levels in diluted bottles were calculated from these measured WSW values and known dilution factors. Coefficients of variation for quadruplicate initial chlorophyll samples averaged 7.9%, 13.5%, and 8.9% for the 20 Âµm size fractions, respectively. During May (all but outer shelf experiments) and July cruises, all diluted bottles and two 100% WSW bottles were enriched with nitrate (4.7 Âµmol L-1 as NaNO3) and phosphate (0.27 Âµmol L-1 as Na2HPO4). The other two 100% WSW bottles were left unenriched. Bottles were screened to collection-depth light levels with neutral density screening and incubated on deck in seawater-cooled incubators for 24 hr. All bottles were then sampled in

	duplicate for size-fractionated chlorophyll (filtration volumes ranged from 0.15 to 1.08 liter depending on WSW chlorophyll and dilution levels); 100% WSW bottles were additionally sampled for microzooplankton abundance and composition. Net growth rates (k, d-1) for total chlorophyll and individual chlorophyll size fractions were calculated as (1/t)(ln[Pt/Po]), where Pt = final chlorophyll concentration, Po = initial chlorophyll concentration, and t = incubation time in d. Intrinsic growth rates (Âµ,d-1) of phytoplankton were estimated from the y-intercept of net growth rates regressed upon fraction WSW. For experiments exhibiting saturated grazing (i.e. a leveling of net growth rate across the least-dilute bottles) (Gallegos 1989), instrinsic growth rate estimates were based on regression of net growth rates in only the most dilute bottles (generally those with ?40% WSW). Microzooplankton grazing rates (g, d-1) were estimated from the slope of the regression for experiments with linear relationships between net growth and fraction WSW, and as g = µn - kn (where kn = net growth rate of phytoplankton in enriched, 100% WSW bottles) for experiments with saturated grazing. In experiments with nutrient enrichment, unenriched phytoplankton growth rates (µo) were calculated as µo = ko + g, where ko = net growth rate of phytoplankton in unenriched, 100% WSW bottles. Estimates of µo were used to compare microzooplankton grazing to phytoplankton growth in situ (g : µo). These ratios represent the fraction of primary production consumed each day by microzooplankton grazing. Ratios were arctan transformed for estimation of means and standard deviations. More detailed methods reference: Strom, et al. (2006) Cross-shelf gradients in phytoplankton community structure, nutrient utilization, and growth rate in the coastal Gulf of Alaska. Marine Ecology Progress Series (in press)

HX244

Website	https://www.bco-dmo.org/deployment/57525
Platform	R/V Alpha Helix
Report	http://globec.whoi.edu/nep/reports/cgoa_cruises/hx244cr.pdf
Start Date	2001-05-17
End Date	2001-05-31
	Original cruise data are available from the NSF R2R data catalog **Acquisition Description**

Description	[excerpted from Strom, et al. (2006) Microzooplankton grazing in the coastal Gulf of Alaska: Variations in top-down control of phytoplankton. Limnol Oceanogr in press.] Water drawn from multiple Niskin bottles closed at a single depth was pooled into two 25-liter polycarbonate carboys. Most often, water was collected from the depth corresponding to 50% of surface irradiance (50% Io, 3 to 10 m). Once during April, and once per station during July, water was collected from the depth of the subsurface chlorophyll maximum (SCM, 12 to 25 m). The contents of one carboy were gravity-filtered (0.2 ÂµÂµm) to generate particle-free filtered seawater (FSW, the diluent for the dilution series). The contents of the other were gently pre-screened through 200 ÂµÂµm Nitex mesh to exclude macrozooplankton (WSW, the whole seawater for the dilution series). Using gentle siphoning and mixing techniques, FSW and WSW were combined in known proportions in 2.35-liter polycarbonate bottles to generate a dilution series consisting of 9, 16, 24, 41, 61, and 100% WSW (each in duplicate). An additional pair of bottles diluted to 4% was added during the May and July cruises, as well as an additional pair of 100% WSW bottles to control for the effects of nutrient enrichment on phytoplankton growth rate. Clean techniques and inert materials (silicone, polycarbonate) were used throughout. **Processing Description** Initial samples for size-fractionated chlorophyll (20 µm, in quadruplicate), nutrients (nitrate, nitrite, silicic acid, phosphate), and microzooplankton abundance and composition (in duplicate, see below) were taken from the WSW carboy at intervals during experiment set-up. Initial chlorophyll levels in diluted bottles were calculated from these measured WSW values and known dilution factors. Coefficients of variation for quadruplicate initial chlorophyll samples averaged 7.9%, 13.5%, and 8.9% for the 20 µm size fractions, respectively. During May (all but outer shelf experiments) and July cruises, all diluted bottles and two 100% WSW bottles were enriched with nitrate (4.7 µmol L-1 as NaNO3) and phosphate (0.27 µmol L-1 as Na2HPO4). The other two 100% WSW bottles were left unenriched. Bottles were screened to collection-depth light levels with neutral density screening and incubated on deck in seawater-cooled incubators for 24 hr. All bottles were then sampled in duplicate for size-fractionated chlorophyll (filtration volumes ranged from 0.15 to 1.08 liter depending on WSW chlorophyll and dilution levels); 100% WSW bottles were additionally sampled for microzooplankton abundance and composition. Net growth rates (k, d-1) for total chlorophyll and individual chlorophyll size fractions were calculated as (1/t)(ln[Pt/Po]), where Pt = final chlorophyll concentration, Po = initial chlorophyll concentration, and t =

	incubation time in d. Intrinsic growth rates (µ,d-1) of phytoplankton were estimated from the y-intercept of net growth rates regressed upon fraction WSW. For experiments exhibiting saturated grazing (i.e. a leveling of net growth rate across the least-dilute bottles) (Gallegos 1989), instrinsic growth rate estimates were based on regression of net growth rates in only the most dilute bottles (generally those with ?40% WSW). Microzooplankton grazing rates (g, d-1) were estimated from the slope of the regression for experiments with linear relationships between net growth and fraction WSW, and as g = µn - kn (where kn = net growth rate of phytoplankton in enriched, 100% WSW bottles) for experiments with saturated grazing. In experiments with nutrient enrichment, unenriched phytoplankton growth rates (µo) were calculated as µo = ko + g, where ko = net growth rate of phytoplankton in unenriched, 100% WSW bottles. Estimates of µo were used to compare microzooplankton grazing to phytoplankton growth in situ (g : µo). These ratios represent the fraction of primary production consumed each day by microzooplankton grazing. Ratios were arctan transformed for estimation of means and standard deviations. More detailed methods reference: Strom, et al. (2006) Cross-shelf gradients in phytoplankton community structure, nutrient utilization, and growth rate in the coastal Gulf of Alaska. Marine Ecology Progress Series (in press)

HX247

Website	https://www.bco-dmo.org/deployment/57527
Platform	R/V Alpha Helix
Report	http://globec.whoi.edu/nep/reports/cgoa_cruises/hx247cr.pdf
Start Date	2001-07-12
End Date	2001-07-26
	Original cruise data are available from the NSF R2R data catalog **Acquisition Description** [excerpted from Strom, et al. (2006) Microzooplankton grazing in the coastal Gulf of Alaska: Variations in top-down control of phytoplankton. Limnol Oceanogr in press.] Water drawn from multiple Niskin bottles closed at a single depth was pooled into two 25-liter polycarbonate carboys. Most often, water was collected from the depth corresponding to 50% of surface irradiance (50% Io, 3 to 10 m). Once during April, and once per station during July, water was collected from the depth of the subsurface chlorophyll maximum (SCM, 12 to 25 m). The contents of one carboy were gravity-filtered (0.2 Âµm) to

Description	generate particle-free filtered seawater (FSW, the diluent for the dilution series). The contents of the other were gently pre-screened through 200 Âµm Nitex mesh to exclude macrozooplankton (WSW, the whole seawater for the dilution series). Using gentle siphoning and mixing techniques, FSW and WSW were combined in known proportions in 2.35-liter polycarbonate bottles to generate a dilution series consisting of 9, 16, 24, 41, 61, and 100% WSW (each in duplicate). An additional pair of bottles diluted to 4% was added during the May and July cruises, as well as an additional pair of 100% WSW bottles to control for the effects of nutrient enrichment on phytoplankton growth rate. Clean techniques and inert materials (silicone, polycarbonate) were used throughout. **Processing Description** Initial samples for size-fractionated chlorophyll (20 µm, in quadruplicate), nutrients (nitrate, nitrite, silicic acid, phosphate), and microzooplankton abundance and composition (in duplicate, see below) were taken from the WSW carboy at intervals during experiment set-up. Initial chlorophyll levels in diluted bottles were calculated from these measured WSW values and known dilution factors. Coefficients of variation for quadruplicate initial chlorophyll samples averaged 7.9%, 13.5%, and 8.9% for the 20 µm size fractions, respectively. During May (all but outer shelf experiments) and July cruises, all diluted bottles and two 100% WSW bottles were enriched with nitrate (4.7 µmol L-1 as NaNO3) and phosphate (0.27 µmol L-1 as Na2HPO4). The other two 100% WSW bottles were left unenriched. Bottles were screened to collection-depth light levels with neutral density screening and incubated on deck in seawater-cooled incubators for 24 hr. All bottles were then sampled in duplicate for size-fractionated chlorophyll (filtration volumes ranged from 0.15 to 1.08 liter depending on WSW chlorophyll and dilution levels); 100% WSW bottles were additionally sampled for microzooplankton abundance and composition. Net growth rates (k, d-1) for total chlorophyll and individual chlorophyll size fractions were calculated as (1/t)(ln[Pt/Po]), where Pt = final chlorophyll concentration, Po = initial chlorophyll concentration, and t = incubation time in d. Intrinsic growth rates (µ,d-1) of phytoplankton were estimated from the y-intercept of net growth rates regressed upon fraction WSW. For experiments exhibiting saturated grazing (i.e. a leveling of net growth rate across the least-dilute bottles) (Gallegos 1989), instrinsic growth rate estimates were based on regression of net growth rates in only the most dilute bottles (generally those with ?40% WSW). Microzooplankton grazing rates (g, d-1) were estimated from the slope of the regression for experiments with linear relationships between net growth and fraction WSW, and as g = µn

	- kn (where kn = net growth rate of phytoplankton in enriched, 100% WSW bottles) for experiments with saturated grazing. In experiments with nutrient enrichment, unenriched phytoplankton growth rates (µo) were calculated as µo = ko + g, where ko = net growth rate of phytoplankton in unenriched, 100% WSW bottles. Estimates of µo were used to compare microzooplankton grazing to phytoplankton growth in situ (g : µo). These ratios represent the fraction of primary production consumed each day by microzooplankton grazing. Ratios were arctan transformed for estimation of means and standard deviations. More detailed methods reference: Strom, et al. (2006) Cross-shelf gradients in phytoplankton community structure, nutrient utilization, and growth rate in the coastal Gulf of Alaska. Marine Ecology Progress Series (in press)

HX271

Website	https://www.bco-dmo.org/deployment/57540
Platform	R/V Alpha Helix
Report	http://globec.whoi.edu/nep/reports/cgoa_cruises/hx271cr.pdf
Start Date	2003-04-24
End Date	2003-05-15
Description	Original cruise data are available from the NSF R2R data catalog

HX275

Website	https://www.bco-dmo.org/deployment/57542
Platform	R/V Alpha Helix
Report	http://globec.whoi.edu/nep/reports/cgoa_cruises/hx275cr.pdf
Start Date	2003-07-20
End Date	2003-08-12
Description	Original cruise data are available from the NSF R2R data catalog

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Project Information

U.S. GLOBEC Northeast Pacific (NEP)

Website: http://nepglobec.bco-dmo.org

Coverage: Northeast Pacific Ocean, Gulf of Alaska

Program in a Nutshell Goal: To understand the effects of climate variability and climate change on the distribution, abundance and production of marine animals (including commercially important living marine resources) in the eastern North Pacific. To embody this understanding in diagnostic and prognostic ecosystem models, capable of capturing the ecosystem response to major climatic fluctuations. Approach: To study the effects of past and present climate variability on the population ecology and population dynamics of marine biota and living marine resources, and to use this information as a proxy for how the ecosystems of the eastern North Pacific may respond to future global climate change. The strong temporal variability in the physical and biological signals of the NEP will be used to examine the biophysical mechanisms through which zooplankton and salmon populations respond to physical forcing and biological interactions in the coastal regions of the two gyres. Annual and interannual variability will be studied directly through long-term observations and detailed process studies; variability at longer time scales will be examined through retrospective analysis of directly measured and proxy data. Coupled biophysical models of the ecosystems of these regions will be developed and tested using the process studies and data collected from the long-term observation programs, then further tested and improved by hindcasting selected retrospective data series.

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Program Information

U.S. GLOBal ocean ECosystems dynamics (U.S. GLOBEC)

Website: http://www.usglobec.org/

Coverage: Global

U.S. GLOBEC (GLOBal ocean ECosystems dynamics) is a research program organized by oceanographers and fisheries scientists to address the question of how global climate change may affect the abundance and production of animals in the sea. The U.S. GLOBEC Program currently had major research efforts underway in the Georges Bank / Northwest Atlantic Region, and the Northeast Pacific (with components in the California Current and in the Coastal Gulf of Alaska). U.S. GLOBEC was a major contributor to International GLOBEC efforts in the Southern Ocean and Western Antarctic Peninsula (WAP).

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0101397
National Oceanic and Atmospheric Administration (NOAA)	unknown NEP NOAA

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