Project Number: 901618

Project Start: Jan. 1, 2016[1] **Project Duration (in years): Yr 2 of 5**

Please indicate if proposal includes requests for any of the following (mark all that apply).

Ship Time	ROV	AUV	Wave Glider	Mini ROV
x	x		x	

Please indicate what type of project is being proposed (mark only one).

Feasibility/Scoping [Less than 100 days effort]	Development[2]	Research	Infrastructure[2]	Education
		x		

Time Series	Institute Initiative

Project Manager[3]: Crissy Huffard
Principal Investigator: Ken Smith
Lead Scientist: Ken Smith
Lead Engineer: Alana Sherman

Project Title: Pelagic-Benthic Coupling and the Carbon Cycle

[1] This date and number should remain the same for the duration of the project. If your project start date for 2017 is not January 1, please indicate the start date in the first cell of the milestone chart. Format for duration example: "Year 2 of 5".
[2] Development and infrastructure projects must complete the risk matrix (see item #5 at the end of the proposal form).
[3] Not all projects will require all four titles to be filled in. Please indicate individuals only for those titles that are appropriate for your project.

1) ABSTRACT (new projects only)

[Paste abstract here]

2) PROPOSAL

a) New Projects

Statement of the problem, why it is important

[Click here to enter text]

How does it relate/contribute to MBARI's mission and strategic plan?

[Click here to enter text]

How does it relate/contribute to the Packard Foundation's Ocean Visions Grantmaking policies?
(See http://mww.mbari.org/oed/OED_Documents.htm#Packard for documents.)

[Click here to enter text]

Does it relate to the Technology Roadmap? If so, please describe how.
(See http://mww.mbari.org/oed/TechnologyRoadmap.pdf.)

[Click here to enter text]

Approach to the problem

[Click here to enter text]

Publications (from other projects over the last 5 years)

[Click here to enter text]

b) Continuing Projects

If the proposed project includes multiple individual projects, please list each of these projects as a subheading in the proposal. For each subheading, please address the following:

Current status of project and results to date

1. Continue to study and document impacts of global warming in abyssal areas of world ocean (Smith et al. 2013. PNAS, see below).
2. Continue to increase the duration of autonomous instrumentation to operate for periods of one year.
3. Benthic Rover has now been deployed for over 4 years at Sta. M with the latest records through June 2015 published (Smith et al., 2016). Benthic Rover is currently deployed for one year from November 2015 to November 2016.
4. Sedimentation Event Sensor (SES) has now been deployed for 3.5 years at Sta. M. A description of the instrument and the initial results is now in press (McGill et al., 2016, see below). The SES is currently deployed for one year from November 2015 to November 2016.
5. Benthic time-lapse camera continues to take hourly digital images of the sea-floor. This camera system is now deployed for one year, from November 2015 to November 2016.
6. A new benthic time-lapse system with near-field and far-field cameras mounted and synchronized on one tripod frame underwent a one-week test this June at Smooth Ridge. This system will be deployed at Sta. M in November 2016 until April 2017 for a 5-month test deployment, and then again from April – Nov 2017.
7. All time-series data from Sta. M are being incorporated into the VARS database and the Integrated Time-Series project.
8. Digitizing Sta. M time-lapse camera archives (1989- 2006) from film to digital image files is now completed. Digitizing camera sled film archives from Sta. M (1989- 2006) in progress for completion in 2016. We are currently in the process of conducting quality control after which these newly digitized images will be incorporated into VARS. The frame-by-frame order of approximately 125,000 images from approximately 60 camera sled deployments and 50 camera tripod deployments must be verified. At minimum it takes many hours to verify each deployment image set that is already in order. In extreme cases, deployments with images scanned out of order can take over one week to fix. We estimate one third of image sets will require some degree of re-ordering before files can be renamed by time code and uploaded into VARS. This work is not complex but requires attention to detail, and uninterrupted hours of focus. We currently have a CSUMB Masters student in the lab who will use data from this archive for her thesis project. If she takes charge in reordering image sets, then she will see the full archive of imagery and gain a broad understanding of the archive's changes over time. This experience will make her Masters project data collection more efficient and much more meaningful.
9. After some manufacturer delays, the new LED lights have been procured and testing has begun to evaluate whether these lights will provide an appropriate replacement for our current strobes. As of now we are still determining if these lights are a feasible approach.
10. Assess benthopelagic community using acoustic backscatter. A proof-of-concept multibeam data set from the mapping AUV at Smooth Ridge (~900 m depth) has been processed and submitted for peer-review publication (Dunlop, K.M., K.J. Benoit-Bird, C.M. Waluk, T. Jarvis, D.W. Caress, H. Thomas, K.L. Smith, Jr. Visualizing bathyal benthopelagic fauna from a mapping AUV using multibeam sonar). We are continuing this collaboration to process future data sets from Sta. M to evaluate the role of benthopelagic fauna in the deep-sea carbon cycle. The T-20 multibeam will be mounted on Doc Ricketts to record backscatter data from Sta. M in November 2016.[This research activity of testing the T-20 to record acoustic backscatter data at Sta. M is a complementary activity in the Park-N-Fly scoping/feasibility project (901606)].

11. We have begun testing protocols to evaluate free-living and particulate-associated microbial communities at Sta. M and MARS (Figure 1). Chris Preston is collaborating with us to develop a new technique for assessing the diversity of free-living microbes in the water column. We have begun to test this technique with water sampling at Sta. M (Nov 2015) and MARS (June 2016). This method involves fractionation of whole seawater (collected using Niskin bottles) through filters of different porosities. For assessing microbial diversity of sinking particulate matter, we have also tested the use of RNA later as a fixative in a one-week sediment trap deployment at MARS. We plan to use both of these methods at Sta. M in Nov 2016 with ROV water sampling combined with a 5-month sediment trap deployment using specialized collection and preservative techniques for microbial studies. In addition, we have initiated a collaboration with Colleen Durkin at MLML to study the composition of sinking particulates. Colleen and Chris are working to develop a method for assessing particulate-associated microbial communities. These studies are being led by Chris Preston (320 hours).
12. Collaborate with Colleen Durkin, MLML, in studying how the phytoplankton collected in our long time-series sediment trap collections at Sta. M have changed with respect to changing climate. To fund this study, a solicited Sea-Grant proposal was submitted this month by Durkin and Smith ("How does climate change affect the export of phytoplankton to the seafloor?")
13. Collaborate with CSUMB graduate students, Larissa Lemon and Danielle Fabian in the Lindholm lab on their Masters research using Sta. M time-series data. Larissa is currently drafting her thesis proposal, and Danielle (also an MBARI summer intern) is beginning data collection and project design.

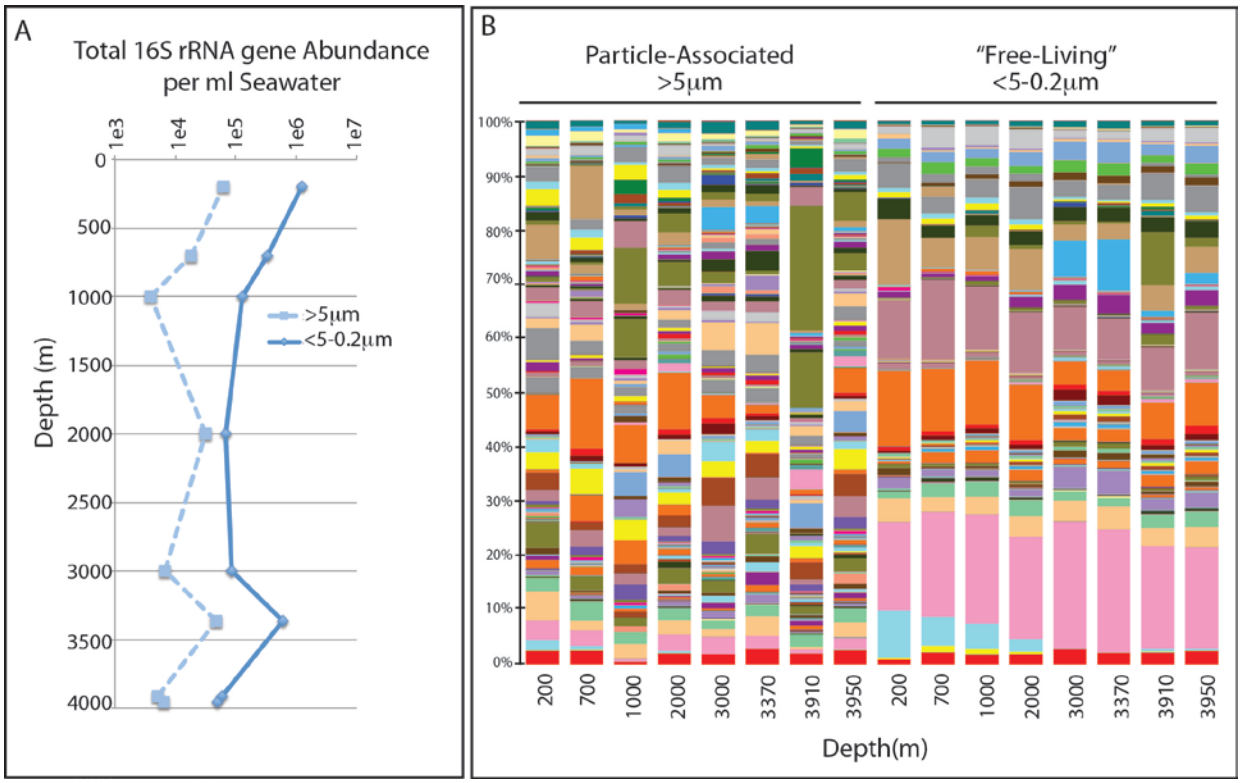

Figure 1. The abundance (A) and diversity (B) of 16S rRNA genes in size-fractionated water column samples collected at Station M in November 2015. Color bars in panel B represent the relative

abundance of microbial genera from 16S rRNA tag sequencing. The greater than 5um fraction contained fewer 16S rRNA genes, but was more diverse and variable than the <5um – 0.2um fraction. 16S rRNA genes originating from photosynthetic organisms (<0.4% of total) were detected at all depths except 1000m. Photosynthetic groups included *Prochlorococcus*, *Synechococcus*, and chloroplasts from *Chlorophyta*, *Cryptophyta*, *Haptophyceae*, *Stramenopiles*, and *Streptophyta*.

Significant changes from previous project proposal

None

Publications based on the results of this project only

2016

1. K.L. Smith, Jr., C.L. Huffard, A.D. Sherman, H.A. Ruhl. Decadal change in sediment community oxygen consumption in the abyssal Northeast Pacific. Aquat. Geochem. doi:1007/s10498-016-9293-3. (17 pages)
2. Huffard, C.L., L.A. Kuhnz, L. Lemon, A.D. Sherman, K.L. Smith Jr. Demographic indicators of change in a deposit-feeding abyssal holothurian community (Station M, 4000m). Deep-Sea Res I; 109:27-39.
3. Laguionie-Marchais, C., G.L.J. Paterson, B.J. Bett, K.L. Smith, Jr, H.A. Ruhl. Inter-annual species-level variations in an abyssal polychaete assemblage (Sta. M, NE Pacific, 4000m). Prog. Oceanogr. 140:43-53.
4. Dunlop, K.M., D. van Oevelen, H.A. Ruhl, C.L. Huffard, L.A. Kuhnz, K.L. Smith, Jr. Carbon cycling in the deep eastern North Pacific benthic food web: Investigating the effect of organic carbon input. Limnol. Oceanogr. doi: 10.1002/lno.10345 (13 pages)
5. McGill, P.R., R.G. Henthorn, L.E. Bird, C.L. Huffard, D.V. Klimov and K.L. Smith, Jr. Sedimentation Event Sensor: a new ocean instrument for in-situ imaging and fluorometry of sinking particulate matter. Limnol. Oceanogr. Methods doi: 10.1002/lom3.10131 (11 pages)

2015

1. K.L. Smith, Jr., M. Messié, A.D. Sherman, C.L. Huffard, B.W. Hobson, H.A. Ruhl, A. Boetius. Navigating the vital but imperiled future of global oceanic time-series. EOS 96, doi: 10.1029/2015EO038095 (8 pages)
2. Laguionie-Marchais, C., L.A. Kuhnz, L.A., C.L. Huffard, H.A. Ruhl, K.L. Smith, Jr. Spatial and temporal variation in sponge spicule patches at Station M, North East Pacific Mar. Biol. 162:617-624
3. K.M. Dunlop, L.A. Kuhnz, H.A. Ruhl, C.L. Huffard, D.W. Caress, R.G. Henthorn, B.W. Hobson, P. McGill, K.L. Smith, Jr. An evaluation of deep-sea benthic megafauna length measurements obtained with laser and stereo camera methods. Deep Sea Res. Pt. I. 96:38-48

2014

1. K.L. Smith, Jr., A.D. Sherman, C.L. Huffard, P.R. McGill, R. Henthorn, S. Von Thun, H.A. Ruhl, M. Kahru and M.D. Ohman. Large salp bloom export from the upper ocean and benthic community response in the abyssal northeast Pacific: Day to week resolution. Limnol. Oceanogr. 59: 745-757.

2. L.A. Kuhnz, H.A. Ruhl, C.L. Huffard and K.L. Smith, Jr. Rapid changes and long-term cycles in the benthic megafaunal community observed over 24 years in the abyssal northeast Pacific. Prog. Oceanogr. 124:1–11.

2013

1. K.L. Smith, Jr., H.A. Ruhl, M. Kahru, C.L. Huffard and A.D. Sherman. Deep ocean communities impacted by changing climate over 24 y in the abyssal northeast Pacific. Proc. Nat. Acad. Sci. 110: 19838-19841.
2. S.E.Wilson, H.A. Ruhl and K.L. Smith, Jr. Zooplankton fecal pellet flux in the abyssal northeast Pacific: a 15 year time-series study. Limnol. Oceanogr. 58: 881 -892.
3. A.S. Kahn, J.B. Geller, H.M. Reiswig and K.L. Smith, Jr. *Bathydorus laniger* and *Docosaccus maculatus* (Lyssacinosida; Hexactinellida): two new species of glass sponge from the abyssal eastern North Pacific Ocean. Zootaxa 3646 (4): 386-400.
4. C. Laguionie-Marchais, D.S.M. Billett, G.L.D. Paterson, H.A. Ruhl, E.H. Soto, K.L. Smith Jr. and S. Thatje. Interannual dynamics of abyssal polychaete communities in the north east Pacific and north east Atlantic – a family level study. Deep-Sea Res.1 75: 175- 186.

2012

1. M.M. Moeseneder, K.L. Smith, Jr., H.A. Ruhl, D.O.B. Jones, U. Witte and J.I. Prosser. Temporal and depth-related differences in prokaryotic communities in abyssal sediments associated with particulate organic carbon flux. Deep-Sea Res. I 70: 26-35.
2. A.S. Kahn, H.A. Ruhl and K.L. Smith, Jr. Temporal changes in deep-sea sponge populations are correlated to changes in surface climate and food supply. Deep-Sea Res. I 70: 36-41.

c) New and Continuing Projects: Plans for 2017

Research Activities
Continuing Activities

1. Continue abyssal time-series at Sta. M using time-lapse cameras, SES and Benthic Rover with yearly servicing to monitor carbon cycle.
2. Use Wave Glider to interrogate and transmit status updates from Rover and SES over year deployment period from November 2016 to November 2017.
3. Collect time-series samples using sequencing sediment traps at 3400 and 3950 m depth and image sea floor with time-lapse cameras to maintain continuity of long-term monitoring.
4. Collect time-series fluorescent and light images of sinking particulate matter at 3950 m depth using the SES, for comparison with concurrent sequencing sediment trap samples from the same depth, over 12-month sampling period. Fluorescent and light images from the SES will also be compared with seafloor fluorescence documented by the Benthic Rover.
5. Collect long time-series measurements of sediment community oxygen consumption (SCOC) with Rover over 12-month period from November 2016 to November 2017.

6. Process time-lapse camera and Rover transit photographs of the sea floor from Sta. M for visible detrital aggregate quantification, bioturbation and faunal activity. Collect ROV video-transect data at Sta. M to determine temporal variation in megafauna abundance, size and distribution. Annotation of video using VARS will require support from video lab, particularly Linda Kuhnz to annotate benthic transects (450 hours) and Susan Von Thun to annotate ascents and descents through the midwater (40 hours annotation, 180 hours at sea).
7. Statistically analyze all of the time-series measurements of faunal abundance, distribution, and species composition, SCOC, and particulate organic matter flux and compare them with satellite color, surface temperature and upwelling strength for correlation with climate indices.
8. Continue incorporating time-series data from Sta. M into VARS for processing and into the ITS project.
9. With help of a research assistant, complete quality control of digitized archived camera tripod and camera sled film images from Sta. M from 1989 through 2006 so that these images can be incorporated into VARS, and available for detailed study both internally and externally (See Current Status of Project, #8 above for details). We are requesting to hire current summer intern Danielle Fabian, with the necessary expertise, as a temporary research assistant to assist with this work, which we plan to complete in 2017 (720 hours).
10. Continue to submit all mooring, Rover, SES and ROV data to Integrated Time-Series (ITS) project (901512) and continue to participate in regular meetings to progress the collaborative vision of this project.
11. Continue to collaborate with Chris Preston on studying the diversity of microbial populations in the abyssal water column, either free-living or attached to particulate matter.
12. Continue to collaborate with Colleen Durkin (MLML) on the export of phytoplankton to the sea floor at Sta. M
13. Continue to collaborate with CSUMB graduate student, Larissa Lemon, in the Lindholm lab on her Masters research using Sta. M time-series data.
14. Continue to collaborate with CSUMB graduate student, Danielle Fabian, in the Lindholm lab on her Masters research using Sta. M time-series data.
15. Continue using grab respirometers to ground-truth Rover SCOC and collect sediment for macrofauna and carbon analyses on cruises in April and November 2017.

New Activities

1. Expand time-series measurements to include the benthopelagic community, a critical component of the deep-sea ecosystem, using backscatter data from the T-20 multibeam configured on ROV Ricketts. Echoview software will be used to process these data in collaboration with Kathy Dunlop and Kelly Benoit-Bird as in our past effort (see Current status of project #10 above). This research activity of testing the T-20 to record acoustic backscatter data at Sta. M is a complementary activity in the Park-N-Fly project (901606).
2. Preparations for a synthesis of 30-years of time-series studies at Sta. M (1989-2019). We plan to publish a special volume of Deep-Sea Research Part II in 2019 as a sequel to our 1998 volume [DSR II, vol.45 (4-50)]. I have invited many previous and current investigators to contribute to this volume, offering opportunities to participate on our two proposed cruises to Sta. M in 2017. Sixteen people, external to MBARI, have expressed interest in these cruises, and over twenty peer-reviewed paper titles have been proposed. These chemical and biological contributions will

provide valuable time-series data on the carbon cycle at abyssal depths critical to the ITS project (901512). To further support this 30-year milestone, we plan to submit an NSF proposal in February 2017 to provide additional cruise support for seasonal sampling to augment proposed requests on WF in 2018. This NSF proposal and requested shiptime will permit a wider variety of deep sampling using instrumentation and trawling capabilities not possible on WF.

Engineering/technology development

1. **Engineering support of the time-lapse camera and sedimentation event sensor (SES)** will be required for maintenance at sea. This support will likely include debugging hardware issues, creating deployment scripts, and cruise support to deploy and recover these free-vehicle instruments. A second time-lapse camera, instrumented with the new controller, will be deployed in November 2016 at Sta. M. This system will be tested in parallel with the existing camera system for a year before replacing the old camera controller.
2. **Engineering support of the Rover** will be required for maintenance at sea after a year-long deployment.
3. **Develop a time-lapse system with near and far-field cameras** slaved to strobes with common field of illumination. The development began in 2016 with one-week testing at Smooth Ridge in June. Further testing is required at Sta. M on cruises in April and November 2017. The near-field camera will provide temporal detail of sediment surface changes for comparison with broader spatial scale transects now provided by Rover and ROV and future transects with Park-n-Fly AUV (project # 901606).
4. **Research a stand-alone, upward profiling current meter** to integrate into the new camera system with near and far-field cameras for year-long recording of acoustic backscatter intensity in the overlying water column $\leq$ 50 m above bottom. These data will be compared to short-term T-20 multibeam data from ROV transects in April and November 2017.
5. **Develop acoustic modem capability in SES to communicate with Park-n-Fly AUV.** We propose to use large settling events of particulate matter recorded by the SES to trigger Park-n-Fly AUV transects at Sta. M. This development will be timed to coincide with the projected development of the Park-n-Fly vehicle (project #901606).
6. We plan to continue work on **porting Laser Measure in order to improve the quantitative data obtained from images and ROV video**. (This project has been deferred since 2014 because of insufficient engineering time – B. Schlining) The Laser Measure hardware system consists of 3 lasers that are mounted on the ROV and projected into the camera's field of view, creating laser fiducial points. The spacing between the different fiducial points will be used to calculate the camera's attitude and field of view relative to the viewed surface. Dan Davis originally wrote the Laser Measure software in Optimus (Adept, 2013). The application of this software proved to be a bottleneck to its adoption as it required an Optimus license, a custom data flow to work with images, and a great deal of user input to operate. We are proposing to re-implement the algorithms, removing the requirement for Optimus. Our initial goal is to apply the laser measurement analysis to still images. Future development could include novel applications such as real time measurement grid overlays on video. This work, along with additional VARS improvements, will be completed by Brian Schlining (300 hours Laser Measure, 100 hours VARS support) and Paul McGill (40 hours).

Field programs (detail ship requirements/deployments/diver requirements)

1. Western Flyer/Ricketts – one 7-day cruise to Sta. M in April 2017 with collaborators contributing to the journal volume commemorating 30-years of studies at Sta. M. We will conduct benthic video transects and acoustic backscatter surveys using the Doc Ricketts. Collaborators will conduct chemical and biological measurements and experiments on the sea floor and water column. A second station, 40 km to the northeast of Sta. M, will be visited on this cruise to address a critical question of benthic and pelagic megafauna migration on broader spatial scales.
2. Western Flyer/Ricketts – One 10-day cruise to Sta. M in November 2017 to conduct annual servicing of Rover, SES and sediment trap/time-lapse camera mooring. Doc Ricketts will be used to conduct benthic video and acoustic backscatter surveys at Sta. M in addition to conducting measurements and experiments on the sea floor with collaborators.
3. Wave Glider– Five 12-day deployments to Sta. M in January, April, July, September and November 2017 to communicate with Rover and SES. Also rendezvous during Western Flyer cruises in April and November 2017.

Isotope Usage

Project teams must provide details regarding any planned isotope use on shore, on ships, in the Sanctuary, etc. Please review the guidance on isotope usage at http://www.mbari.org/at-sea/cruise-planning/hazardous-materials/ and policy at http://mww.mbari.org/safety/SafetyManual/Isotope_Use_Policy.pdf, and then provide details on plans below.

None

Specific deliverables

1. Continue publication of time-series results on pelagic-benthic coupling in refereed journals (as above). We are especially interested in documenting the 2015-2016 El Niño impacts on abyssal communities at Sta. M which will be possible after recovery and data processing from sediment trap/time-lapse camera, Rover and SES deployed November 2015 to November 2016.
2. Continue publication of further engineering development of instrumentation such as acoustic communication links between Wave Glider and the Rover and SES, in refereed journals (as above).
3. Continue processing new and existing time-lapse photographs using VARS software. Complete quality control of digitized images.
4. Use VARS to analyze benthic video images from the Ricketts.
5. Continue efforts to use T-20 multibeam to measure distribution and abundance of pelagic fauna as backscatter targets in proximity to the sea floor.
6. Continue to work with Integrated Time Series project, providing data and guidance.
7. Continue to work with Park-n-Fly development project, providing scientific guidance and logistical support for component testing at Sta. M.

Milestones (see personnel classification list)

[Click here to enter text]

2017 Project Start Date: MM/DD/2017	**Milestone 1**	**Milestone 2**	**Milestone 3**	**Milestone 4**	**Milestone 5**	**Milestone 6**	**Milestone 7**	**Total Resources[4]** for each resource category for all milestones listed here
Milestone Date	**All year**	**April 2017**	**Nov 2017**	**Jan-September**	**April, Nov 2017**	**All year**	**All year**	
Milestone Description	**Support of all instruments and use of VARS**	**Sta. M cruise w/ T-20 backscatter recording**	**Sta. M annual cruise w/ T-20 backscatter recording**	**Quality control of digitized files**	**Evaluation of microbial sampling system**	**Preparation of manuscripts**	**Laser Measure**	
EE	**200 A.S. 200 P.M.**	**100 A.S. 100 P.M.**	**100 A.S. 100 P.M.**			**100 A.S. 50 P.M.**	**40 P.M.**	**500 A.S. 490 P.M.**
SE	**100 R.H. 100 B.S.**	**140 R.H.**	**120 R.H.**			**80 R.H. 80 B.K.**	**300 B.S.**	**440 R.H. 80 B.K. 400 B.S.**
ME	**40 B.H. 60 F.C.**							**40 B.H. 60 F.C.**
EE Tech	**80 T.M.**	**80 T.M.**	**80 T.M.**					**240 T.M.**
SE Tech								
ME Tech	**380 J.F.**	**250 J.F.**	**250 J.F.**					**880 J.F.**
Machine Shop								
Divers								
Video lab		**225 L.K. 110 S.V.T.**	**225 L.K. 110 S.V.T.**					**450 L.K. 220 S.V.T.**
RT/RS					**320 C.P.**			**320 C.P.**
Research assistant				**720 D.F.**				**720 D.F.**

Budget justification

Budget justification

[4] This number should be the same number you entered on the resource requests for this particular resource.

1. Open house supplies – Funds to improve our interactive open house display "Climate Change in Extreme Environments."
2. Alkaline batteries – Alkaline battery packs are needed to refurbish power units in the beacons, strobes, current meter, sediment trap, and benthic respirometers.
3. Alkaline batteries for testing the near-field camera and far-field camera tripod combination on two cruises. We estimated the costs of all batteries needed plus tax and 10% inflation.
4. Jars for sample collection –jars are required for sediment trap samples, along with specimens collected for sizing verification and species descriptions. We generally ask for fixative as well, but currently have enough to last through 2017.
5. Lab instrument maintenance and calibration – Funds to service laboratory equipment not covered by divisional funds. Funds to calibrate and service the current meter, optodes, and data loggers.
6. Cruise supplies – Various supplies needed for cruises such as black tape, spray lubricants, rigging hardware, and hand tools.
7. Benthos release batteries – Benthos releases are used for acoustic recall of the Camera Tripod moorings (x 2 moorings) and the SES. We are requesting funds to purchase sufficient batteries for one deployment of the primary Sta. M instrumentation suite and two deployments of the combination tripod in 2017, plus two spares = 10 packs @ $300/pack = $3000.
8. CHN analysis for sediment trap, grab respirometer, and push core samples (POC flux and carbon storage measurements) –The requested funds would cover analysis of all samples for 2017.
9. Quality control of digitized film archive—We request funds to hire a research assistant to ensure the frame-by-frame order of the camera tripod and camera sled image archives so they can be uploaded to VARS. 720 hours @ $17/hr = $12240
10. Microbial Budget – We are collaborating with Chris Preston to develop microbial sampling methods. The total budget for these analyses is $ 8706 Sigma Aldrich supplies = $950, MoBio extractions = $1692, Barcodes (Stanford and Illumina) = $3256, Reactions (Life Technologies) = $2808]. If costs of this aspect must be trimmed, it might be possible to reduce this request by $1600 if analyses can be combined into a single run with Stanford.
11. Argos beacon – If the second camera tripod system were to surface unexpectedly, we would need to know its surface time and location. The only way to gain this information is with a satellite beacon.
12. Travel – Travel and conference fees for Crissy Huffard and Ken Smith to attend and present at ASLO in Hawaii. Smith will present Rover results and Huffard will present Station M results.
13. Lithium Battery Packs – Battery budget was based on deploying Rover, SES and primary Camera Tripod for a 12-month deployment starting in November 2017. All of these instruments will require lithium batteries sufficient for a 12-month deployment. We've budgeted for 10% inflation over last year's costs.
14. Rover, SES and Camera Tripod servicing budgets – Funds are requested for funds for general maintenance, minor upgrades, and acquisition of spares for currently deployed instruments. Although this may sound like a lot of money, one set of titanium connectors on the Rover cost over $3000 to replace.
15. Current meter- Funds are requested to purchase a WHS600-6000 is a 6000m depth-rated Workhorse 600kHz Sentinel with 256MB Memory to allow for time-series acoustics backscatter monitoring of the water column above the camera tripod.

2017		
budget category	**item**	**cost**

Conference registration	Conference registration –ASLO Smith	650
Conference registration	Conference registration –ASLO Huffard	650
Maintenance and repair	Resources to handle maintenance and calibration for lab equipment not covered by divisional funds.	2000
Maintenance and repair	Rover servicing budget	12000
Maintenance and repair	SES servicing budget	10000
Maintenance and repair	Camera tripod servicing budget	5000
Outside Srvc- General	Argos service	2000
Outside Srvc- General	CHN Analysis of one sediment trap deployment and two cruises of push core samples at Sta. M	6000
Outside Srvc- General	Quality control of digital film archive	12240
Postage/Shipping	Postage/Shipping	2000
Capital item >$5000	Upward looking ADCP	31,930
Supplies- General	Open House display supplies	500
Supplies- General	Cruise supplies	3500
Supplies- General	Ballast material for moorings, Rover, and SES	1,000
Supplies- General	Alkaline batteries for sediment traps, beacons, strobes.	1150
Supplies- General	10 Battery Packs for Benthos Releases @ $300 each- Station M	3000
Supplies- General	Alkaline batteries for two deployments of the Combo camera tripod	3141
Supplies- General	Current meter (Camera Tripod) batteries for Station M	90
Supplies- General	Wabo battery pack- 1 deployment, plus spare	350
Supplies- General	Benthos modem MF battery packs: 1 for Rover 1 for SES	2340
Supplies- General	Lithium Battery packs for one-year Rover deployment beginning Nov 2017	28498
Supplies- General	Li Batts for Primary Camera Tripod for 1-year deployment beginning Nov 2017	8965
Supplies- General	SES lithium battery packs for 1-year deployment beginning Nov 2017	14249
Supplies- Science lab	Jars for sample collection	250
Supplies- Science lab	General science lab supplies	4500
Supplies- Science lab	Microbial analyses	8705
Supplies- General	Argos beacon for new camera tripod	5000
Travel- domestic	Conference travel-ASLO Smith	800
Travel- domestic	Conference meals-ASLO Smith	792
Travel- domestic	Conference lodging-ASLO Smith	1240
Travel- domestic	Conference travel-ASLO Huffard	800
Travel- domestic	Conference meals-ASLO Huffard	792
Travel- domestic	Conference lodging-ASLO Huffard	1240

Project team

Ken Smith, Alana Sherman, Crissy Huffard, Rich Henthorn, Paul McGill, John Ferreira, Brett Hobson, Linda Kuhnz, Susan Von Thun, Brian Schlining, Chris Preston, Larissa Lemon, Danielle Fabian

Project lab and office space requirements
In addition to any changes to current space usage, please also include anticipated office and lab needs for students, postdocs, collaborators, etc.

We would like to keep our current Rover lab space, which we use for Rover, SES, and mooring instrumentation; no additional space is needed.

Data storage requirements (see Todd Ruston for assistance)

1. 128 GB for Rover, SES and time-lapse camera (Project library)
2. 4 TB for quality control of time-lapse camera and camera sled (VARS)
3. 25 GB for additional data files (Pulse)
4. 115 GB for acoustic backscatter files from T-20

Data availability outside project team, uniqueness

1. Time-series digital time-lapse camera images from Sta. M are now available on VARS.
2. Our other data sets including POC Flux and SCOC are being integrated into the time-series data base by Monique Messié and Kevin Gomes (See integrated time-series project - #901512)

R/V *Paragon* Requests
If the project team will be requesting time for the R/V Paragon, please specify the operators in the group and provide estimates of their availability to operate the vessel.

None

Export Regulation
Does the project team anticipate any foreign collaborations or international travel? If so, please identify collaborators by name, institution, and country.

1. Dr. Henry Ruhl, National Oceanography Centre, UK
2. Dr. David Bailey, University of Glasgow, UK
3. Dr. Imants Priede, University of Aberdeen, UK
4. Dr. Kathy Dunlop, International Research Institute, Stravanger, Norway
5. Dr. Anastasios Tselepides, University of Piraeus, Greece

Does the project team plan or anticipate export controlled purchases, shipments, or transfers of items (e.g., research instruments, proprietary data, hand-carried tools or samples) outside the U.S. temporarily or permanently? If yes, please identify country or countries and indicate whether these items will remain under MBARI control while abroad or controlled by others. Will the items be exported to more than one country? Please include foreign collaborator information as described above.

Shipping of sediment and faunal samples to UK under control by Dr. Henry Ruhl

<u>Monterey Bay National Marine Sanctuary (MBNMS)</u>

General Permit

Projects teams need to indicate if any work will be performed that is either: (1) currently authorized under our general permit; or (2) will require that we obtain authorization. The current permit can be viewed at http://mww.mbari.org/pco/permits/mbnms-2015-002_feb2015.pdf. Please see Mandy Allen for questions.

Is a permit with MBNMS required for your work?

No

SESAs (General map)
*Projects will need to indicate whether or not work will be conducted within one of the Monterey Bay National Marine Sanctuary's Ecologically Significant Areas (SESAs). An interactive map can be found on the Sanctuary's SIMoN webpages at http://sanctuarysimon.org/maps/sesa/. (*Note: It may take a moment for the page to load, so please be patient. Also, if prompted for a login, hit "Cancel" and then you will be able to access page.*) To determine if your work will occur in a SESA, specific coordinates can be entered using the locator function (click on the red "target" button in the toolbar at the top of the map). If your work will be conducted in one of these areas, please indicate which area, by number.*

None

Authorizations/Permits from other Agencies or Organizations
Is the project team aware of any other permits or authorizations that will be necessary to perform the proposed work? If so, please list below along with status of authorizations (obtained, pending, need to apply, etc.). Please see Mandy Allen if you have questions.

None

Active Acoustics
We are compiling information on active acoustic use at MBARI. If the project involves using active acoustic instrumentation, please describe plans.

Use of T-20 multibeam on ROV Ricketts to insonify benthic boundary layer at Sta. M. We also use acoustic modems, acoustic releases, and homer beacons at Sta. M. (All this information was given to Mandy Allen as requested earlier this year by Paul McGill).

Risk matrix (development and infrastructure projects only)

	Technical Risk	Organizational Risk	Tech Transfer Risk	Labor Estimate Risk
High				
Medium		X		X
Low	X		X	