COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 15-1

NSF 15-535 **05/06/15**

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

DEB - Long-Term Ecological Research

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

1545288

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
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EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

956006145

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

University of California-Santa Barbara

AWARDEE ORGANIZATION CODE (IF KNOWN)

0013201000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Office of Research
Rm 3227 Cheadle Hall
SANTA BARBARA, CA 93106-2050

NAME OF PRIMARY PLACE OF PERF

National Center for Ecological Analysis and Synthesis

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE

National Center for Ecological Analysis and Synthesis
735 State Street, Suite 300
Santa Barbara ,CA ,931015504 ,US.

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Long Term Ecological Research (LTER) National Communications Office (LNCO)**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ **3,197,985**	**48** months	**10/01/15**	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☒ FUNDING MECHANISM **Research - other than RAPID or EAGER**

☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)

☒ COLLABORATIVE STATUS
Not a collaborative proposal

PI/PD DEPARTMENT
Nat'l Ctr for Ecological Anal. and Syn.

PI/PD FAX NUMBER
805-893-7451

PI/PD POSTAL ADDRESS
375 State Street, Suite 300
University of California
Santa Barbara, CA 93101
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address
PI/PD NAME **Frank W Davis**	**PhD**	**1982**	**805-893-7529**	**fd@bren.ucsb.edu**
CO-PI/PD **Carol Blanchette**	**PhD**	**1994**	**805-961-2311**	**blanchet@lifesci.ucsb.edu**
CO-PI/PD **Jennifer Caselle**	**PhD**	**1997**	**805-893-4188**	**caselle@msi.ucsb.edu**
CO-PI/PD **Stacy R Rebich Hespanha**	**DPhil**	**2011**	**805-893-4188**	**hespanha@nceas.ucsb.edu**
CO-PI/PD **Mark P Schildhauer**	**PhD**	**1991**	**805-892-2509**	**schild@nceas.ucsb.edu**

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide,Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:
(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.
(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)
(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds $5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations. By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:
(1) has filed all Federal tax returns required during the three years preceding this certification;
(2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
(3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME **Janet Kim**	**Electronic Signature**	**May 6 2015 2:16PM**

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER
805-893-3890	**kim@research.ucsb.edu**	**805-893-2611**

Direct for Biological Sciences
Division of Environmental Biology
Long-term Ecological Research

Proposal Classification Form
PI: Davis, Frank / Proposal Number: 1545288

CATEGORY I: INVESTIGATOR STATUS (Select ONE)

- ☐ Beginning Investigator - No previous Federal support as PI or Co-PI, excluding fellowships, dissertations, planning grants, etc.
- ☐ Prior Federal support only
- ☐ Current Federal support only
- ☑ Current & prior Federal support

CATEGORY II: FIELDS OF SCIENCE OTHER THAN BIOLOGY INVOLVED IN THIS RESEARCH (Select 1 to 3)

☐ Astronomy	☐ Engineering	☐ Psychology
☐ Chemistry	☐ Mathematics	☐ Social Sciences
☑ Computer Science	☐ Physics	☐ None of the Above
☑ Geosciences		

CATEGORY III: SUBSTANTIVE AREA (Select 1 to 4)

☐ BIOGEOGRAPHY	☐ Decomposition	☐ Molecular Evolution
☐ Island Biogeography	☐ Biogeochemistry	☐ Methodology/Theory
☐ Historical/ Evolutionary Biogeography	☐ Limnology/Hydrology	☐ Isozymes/ Electrophoresis
☐ Phylogeography	☐ Climate/Microclimate	☐ Nucleic Acid Analysis (general)
☐ Methods/Theory	☐ Whole-System Analysis	☐ Restriction Enzymes
☐ CHROMOSOME STUDIES	☐ Productivity/Biomass	☐ Nucleotide Sequencing
☐ Chromosome Evolution	☐ System Energetics	☐ Nuclear DNA
☐ Chromosome Number	☐ Landscape Dynamics	☐ Mitochondrial DNA
☐ Mutation	☐ Chemical & Biochemical Control	☐ Chloroplast DNA
☐ Mitosis and Meiosis	☐ Global Change	☐ RNA Analysis
☑ COMMUNITY ECOLOGY	☐ Climate Change	☐ DNA Hybridization
☐ Community Analysis	☐ Regional Studies	☐ Recombinant DNA
☐ Community Structure	☐ Global Studies	☐ Amino Acid Sequencing
☐ Community Stability	☐ Forestry	☐ Gene/Genome Mapping
☐ Succession	☐ Resource Management (Wildlife, Fisheries, Range, Other)	☐ Natural Products
☐ Experimental Microcosms/ Mesocosms	☐ Agricultural Ecology	☐ Serology/Immunology
☐ Disturbance	☐ EXTREMOPHILES	☐ PALEONTOLOGY
☐ Patch Dynamics	☐ GENOMICS (Genome sequence, organization, function)	☐ Floristic
☐ Food Webs/ Trophic Structure	☐ Viral	☐ Faunistic
☐ Keystone Species	☐ Microbial	☐ Paleoecology
☐ COMPUTATIONAL BIOLOGY	☐ Fungal	☐ Biostratigraphy
☐ CONSERVATION & RESTORATION BIOLOGY	☐ Plant	☐ Palynology
☐ DATABASES	☐ Animal	☐ Micropaleontology
☑ ECOSYSTEMS LEVEL	☐ MARINE MAMMALS	☐ Paleoclimatology
☐ Physical Structure	☐ MOLECULAR APPROACHES	☐ Archeozoic
		☐ Paleozoic
		☐ Mesozoic

- ☐ Cenozoic
- ☑ POPULATION DYNAMICS & LIFE HISTORY
- ☐ Demography/ Life History
- ☐ Population Cycles
- ☐ Distribution/Patchiness/ Marginal Populations
- ☐ Population Regulation
- ☐ Intraspecific Competition
- ☐ Reproductive Strategies
- ☐ Gender Allocation
- ☐ Metapopulations
- ☐ Extinction
- ☐ POPULATION GENETICS & BREEDING SYSTEMS
- ☐ Variation
- ☐ Microevolution
- ☐ Speciation
- ☐ Hybridization
- ☐ Inbreeding/Outbreeding
- ☐ Gene Flow Measurement
- ☐ Inheritance/Heritability
- ☐ Quantitative Genetics/ QTL Analysis
- ☐ Ecological Genetics
- ☐ Gender Ratios
- ☐ Apomixis/ Parthenogenesis
- ☐ Vegetative Reproduction
- ☑ SPECIES INTERACTIONS
- ☐ Predation
- ☐ Herbivory
- ☐ Omnivory
- ☐ Interspecific Competition
- ☐ Niche Relationships/ Resource Partititioning
- ☐ Pollination/ Seed Dispersal
- ☐ Parasitism
- ☐ Mutualism/ Commensalism
- ☐ Plant/Fungal/ Microbial Interactions
- ☐ Mimicry
- ☐ Animal Pathology
- ☐ Plant Pathology
- ☐ Coevolution
- ☐ Biological Control
- ☐ STATISTICS & MODELING
- ☐ Methods/ Instrumentation/ Software
- ☐ Modeling (general)
- ☐ Statistics (general)
  - ☐ Multivariate Methods
  - ☐ Spatial Statistics & Spatial Modeling
  - ☐ Sampling Design & Analysis
  - ☐ Experimental Design & Analysis
- ☐ SYSTEMATICS
- ☐ Taxonomy/Classification
- ☐ Nomenclature
- ☐ Monograph/Revision
- ☐ Phylogenetics
- ☐ Phenetics/Cladistics/ Numerical Taxonomy
- ☐ Macroevolution
- ☐ NONE OF THE ABOVE

CATEGORY IV: INFRASTRUCTURE (Select 1 to 3)

- ☐ COLLECTIONS/STOCK CULTURES
- ☐ Natural History Collections
- ☑ DATABASES
- ☐ FACILITIES
- ☐ Controlled Environment Facilities
- ☐ Field Stations
  - ☐ Field Facility Structure
  - ☐ Field Facility Equipment
- ☐ LTER Site
- ☐ INDUSTRY PARTICIPATION
- ☐ Technique Development
- ☐ TRACKING SYSTEMS
- ☐ Geographic Information Systems
- ☐ Remote Sensing
- ☐ NONE OF THE ABOVE

CATEGORY V: HABITAT (Select 1 to 2)

TERRESTRIAL HABITATS

- ☑ GENERAL TERRESTRIAL
- ☐ TUNDRA
- ☐ BOREAL FOREST
- ☐ TEMPERATE
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Rain Forest
  - ☐ Mixed Forest
  - ☐ Prairie/Grasslands
  - ☐ Desert
- ☐ SUBTROPICAL
  - ☐ Rain Forest
  - ☐ Seasonal Forest
  - ☐ Savanna
  - ☐ Thornwoods
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Desert
- ☐ TROPICAL
  - ☐ Rain Forest
  - ☐ Seasonal Forest
  - ☐ Savanna
  - ☐ Thornwoods
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Desert
- ☐ CHAPPARAL/ SCLEROPHYLL/ SHRUBLANDS
- ☐ ALPINE
- ☐ MONTANE
- ☐ CLOUD FOREST
- ☐ RIPARIAN ZONES
- ☐ ISLANDS (except Barrier Islands)
- ☐ BEACHES/ DUNES/ SHORES/ BARRIER ISLANDS
- ☐ CAVES/ ROCK OUTCROPS/ CLIFFS
- ☐ CROPLANDS/ FALLOW FIELDS/ PASTURES
- ☐ URBAN/SUBURBAN
- ☐ SUBTERRANEAN/ SOIL/ SEDIMENTS
- ☐ EXTREME TERRESTRIAL ENVIRONMENT
- ☐ AERIAL

AQUATIC HABITATS

- ☑ GENERAL AQUATIC
- ☐ FRESHWATER
  - ☐ Wetlands/Bogs/Swamps
  - ☐ Lakes/Ponds
  - ☐ Rivers/Streams
  - ☐ Reservoirs
- ☐ MARINE
  - ☐ Open Ocean/Continental Shelf
  - ☐ Bathyal
  - ☐ Abyssal
  - ☐ Estuarine
  - ☐ Intertidal/Tidal/Coastal
  - ☐ Coral Reef
  - ☐ HYPERSALINE
- ☐ EXTREME AQUATIC ENVIRONMENT
- ☐ CAVES/ ROCK OUTCROPS/ CLIFFS
- ☐ MANGROVES
- ☐ SUBSURFACE WATERS/ SPRINGS
- ☐ EPHEMERAL POOLS & STREAMS
- ☐ MICROPOOLS (Pitcher Plants, Tree Holes, Other)

MAN-MADE ENVIRONMENTS

- ☐ LABORATORY
- ☐ THEORETICAL SYSTEMS
- ☐ OTHER ARTIFICIAL SYSTEMS

NOT APPLICABLE

- ☐ NOT APPLICABLE

CATEGORY VI: GEOGRAPHIC AREA OF THE RESEARCH (Select 1 to 2)

- ☑ WORLDWIDE
- ☐ NORTH AMERICA
  - ☐ United States
    - ☐ Northeast US (CT, MA, ME, NH, NJ, NY, PA, RI, VT)
    - ☐ Northcentral US (IA, IL, IN, MI, MN, ND, NE, OH, SD, WI)
    - ☐ Northwest US (ID, MT, OR, WA, WY)
    - ☐ Southeast US (DC, DE, FL, GA, MD, NC, SC, WV, VA)
    - ☐ Southcentral US (AL, AR, KS, KY, LA, MO, MS, OK, TN, TX)
    - ☐ Southwest US (AZ, CA, CO, NM, NV, UT)
    - ☐ Alaska
    - ☐ Hawaii
    - ☐ Puerto Rico
  - ☐ Canada
  - ☐ Mexico
- ☐ CENTRAL AMERICA (Mainland)
  - ☐ Caribbean Islands
  - ☐ Bermuda/Bahamas
- ☐ SOUTH AMERICA
  - ☐ Eastern South America (Guyana, Fr. Guiana, Suriname, Brazil)
  - ☐ Northern South America (Colombia, Venezuela)
  - ☐ Southern South America (Chile, Argentina, Uruguay, Paraguay)
  - ☐ Western South America (Ecuador, Peru, Bolivia)
- ☐ EUROPE
  - ☐ Eastern Europe
  - ☐ Russia
  - ☐ Scandinavia
  - ☐ Western Europe
- ☐ ASIA
  - ☐ Central Asia
  - ☐ Far East
  - ☐ Middle East
  - ☐ Siberia
  - ☐ South Asia
  - ☐ Southeast Asia
- ☐ AFRICA
  - ☐ North Africa
  - ☐ African South of the Sahara
    - ☐ East Africa
    - ☐ Madagascar
    - ☐ South Africa
    - ☐ West Africa
- ☐ AUSTRALASIA
  - ☐ Australia
  - ☐ New Zealand
  - ☐ Pacific Islands
- ☐ ANTARCTICA
- ☐ ARCTIC
- ☐ ATLANTIC OCEAN
- ☐ PACIFIC OCEAN
- ☐ INDIAN OCEAN
- ☐ OTHER REGIONS (Not defined)
- ☐ NOT APPLICABLE

CATEGORY VII: CLASSIFICATION OF ORGANISMS (Select 1 to 4)

- ☐ VIRUSES
  - ☐ Bacterial
  - ☐ Plant
  - ☐ Animal
- ☑ PROKARYOTES
  - ☐ Archaea
  - ☐ Cyanobacteria
  - ☐ Bacteria
  - ☐ Noncultured Organisms
- ☐ PROTISTA (PROTOZOA)
  - ☐ Amoebae
  - ☐ Apicomplexa
  - ☐ Ciliophora
  - ☐ Flagellates
  - ☐ Foraminifera
  - ☐ Microspora
  - ☐ Radiolaria
- ☐ FUNGI
  - ☐ Ascomycota
  - ☐ Basidiomycota
  - ☐ Chytridiomycota
  - ☐ Mitosporic Fungi
  - ☐ Oomycota
  - ☐ Zygomycota
- ☐ LICHENS
- ☐ SLIME MOLDS
- ☑ ALGAE
  - ☐ Bacillariophyta (Diatoms)
  - ☐ Charophyta
  - ☐ Chlorophyta
  - ☐ Chrysophyta
  - ☐ Dinoflagellata
  - ☐ Euglenoids
  - ☐ Phaeophyta
  - ☐ Rhodophyta
- ☑ PLANTS
  - ☐ NON-VASCULAR PLANTS
    - ☐ BRYOPHYTA
      - ☐ Anthocerotae (Hornworts)
      - ☐ Hepaticae (Liverworts)
      - ☐ Musci (Mosses)
  - ☐ VASCULAR PLANTS
    - ☐ FERNS & FERN ALLIES
    - ☐ GYMNOSPERMS
      - ☐ Coniferales (Conifers)

- ☐ Cycadales (Cycads)
- ☐ Ginkgoales (Ginkgo)
- ☐ Gnetales (Gnetophytes)
- ☐ ANGIOSPERMS
- ☐ Monocots
- ☐ Arecaceae (Palmae)
- ☐ Cyperaceae
- ☐ Liliaceae
- ☐ Orchidaceae
- ☐ Poaceae (Graminae)
- ☐ Dicots
- ☐ Apiaceae (Umbelliferae)
- ☐ Asteraceae (Compositae)
- ☐ Brassicaceae (Cruciferae)
- ☐ Fabaceae (Leguminosae)
- ☐ Lamiaceae (Labiatae)
- ☐ Rosaceae
- ☐ Solanaceae
- ☑ ANIMALS
- ☐ INVERTEBRATES
- ☐ MESOZOA/PLACOZOA
- ☐ PORIFERA (Sponges)
- ☐ CNIDARIA
- ☐ Hydrozoa (Hydra, etc.)
- ☐ Scyphozoa (Jellyfish)
- ☐ Anthozoa (Corals, Sea Anemones)
- ☐ CTENOPHORA (Comb Jellies)
- ☐ PLATYHELMINTHES (Flatworms)
- ☐ Turbellaria (Planarians)
- ☐ Trematoda (Flukes)
- ☐ Cestoda (Tapeworms)
- ☐ Monogenea (Flukes)
- ☐ GNATHOSTOMULIDA
- ☐ NEMERTINEA (Rynchocoela) (Ribbon Worms)
- ☐ ENTOPROCTA (Bryozoa) (Plant-like Animals)
- ☐ ASCHELMINTHES
- ☐ Gastrotricha
- ☐ Kinorhyncha
- ☐ Loricifera
- ☐ Nematoda (Roundworms)
- ☐ Nematomorpha (Horsehair Worms)
- ☐ Rotifera (Rotatoria)
- ☐ ACANTHOCEPHALA (Spiny-headed Worms)
- ☐ PRIAPULOIDEA
- ☐ BRYOZOA (Ectoprocta) (Plant-like Animals)
- ☐ PHORONIDEA (Lophophorates)
- ☐ BRACHIOPODA (Lamp Shells)
- ☐ MOLLUSCA
- ☐ Monoplacophora
- ☐ Aplacophora (Solenogasters)
- ☐ Polyplacophora (Chitons)
- ☐ Scaphopoda (Tooth Shells)
- ☐ Gastropoda (Snails, Slugs, Limpets)
- ☐ Pelecypoda (Bivalvia) (Clams, Mussels, Oysters, Scallops)
- ☐ Cephalopoda (Squid, Octopus, Nautilus)
- ☐ ANNELIDA (Segmented Worms)
- ☐ Polychaeta (Parapodial Worms)
- ☐ Oligochaeta (Earthworms)
- ☐ Hirudinida (Leeches)
- ☐ POGONOPHORA (Beard Worms)
- ☐ SIPUNCULOIDEA (Peanut Worms)
- ☐ ECHIUROIDEA (Spoon Worms)
- ☐ ARTHROPODA
- ☐ Cheliceriformes
- ☐ Merostomata (Horseshoe Crabs)
- ☐ Pycnogonida (Sea Spiders)
- ☐ Scorpionida (Scorpions)
- ☐ Araneae (True Spiders)
- ☐ Pseudoscorpionida (Pseudoscorpions)
- ☐ Acarina (Free-living Mites)
- ☐ Parasitiformes (Parasitic Ticks & Mites)
- ☐ Crustacea
- ☐ Branchiopoda (Fairy Shrimp, Water Flea)
- ☐ Ostracoda (Sea Lice)
- ☐ Copepoda
- ☐ Cirripedia (Barnacles)
- ☐ Amphipoda (Skeleton Shrimp, Whale Lice, Freshwater Shrimp)
- ☐ Isopoda (Wood Lice, Pillbugs)
- ☐ Decapoda (Lobster, Crayfish, Crabs, Shrimp)
- ☐ Hexapoda (Insecta) (Insects)
- ☐ Apterygota (Springtails, Silverfish, etc.)
- ☐ Odonata (Dragonflies, Damselflies)
- ☐ Ephemeroptera (Mayflies)
- ☐ Orthoptera (Grasshoppers, Crickets)
- ☐ Dictyoptera (Cockroaches, Mantids, Phasmids)
- ☐ Isoptera (Termites)
- ☐ Plecoptera (Stoneflies)
- ☐ Phthiraptera (Mallophaga & Anoplura) (Lice)
- ☐ Hemiptera (including Heteroptera) (True Bugs)
- ☐ Homoptera (Cicadas, Scale Insects, Leafhoppers)
- ☐ Thysanoptera (Thrips)
- ☐ Neuroptera (Lacewings, Dobsonflies, Snakeflies)
- ☐ Trichoptera (Caddisflies)
- ☐ Lepidoptera (Moths, Butterflies)
- ☐ Diptera (Flies, Mosquitoes)
- ☐ Siphonaptera (Fleas)
- ☐ Coleoptera (Beetles)
- ☐ Hymenoptera (Ants, Bees, Wasps, Sawflies)
- ☐ Chilopoda (Centipedes)
- ☐ Diplopoda (Millipedes)
- ☐ Pauropoda
- ☐ Symphyta (Symphyla)
- ☐ PENTASTOMIDA (Linguatulida) (Tongue Worms)
- ☐ TARDIGRADA (Tardigrades, Water Bears)
- ☐ ONYCHOPHORA (Peripatus)
- ☐ CHAETOGNATHA (Arrow Worms)
- ☐ ECHINODERMATA
- ☐ Crinoidea (Sea Lilies, Feather Stars)
- ☐ Asteroidea (Starfish, Sea Stars)
- ☐ Ophiuroidea (Brittle Stars, Serpent Stars)
- ☐ Echinoidea (Sea Urchins, Sand Dollars)
- ☐ Holothuroidea (Sea Cucumbers)
- ☐ HEMICHORDATA (Acorn Worms, Pterobranchs)
- ☐ UROCHORDATA (Tunicata) (Tunicates, Sea Squirts, Salps, Ascideans)
- ☐ CEPHALOCHORDATA (Amphioxus/Lancelet)
- ☐ VERTEBRATES
- ☐ AGNATHA (Hagfish, Lamprey)
- ☐ FISHES
- ☐ Chondrichthyes (Cartilaginous Fishes) (Sharks, Rays, Ratfish)
- ☐ Osteichthyes (Bony Fishes)
- ☐ AMPHIBIA
- ☐ Anura (Frogs, Toads)
- ☐ Urodela (Salamanders, Newts)
- ☐ Gymnophiona (Apoda) (Caecilians)
- ☐ REPTILIA
- ☐ Chelonia (Turtles, Tortoises)
- ☐ Serpentes (Snakes)
- ☐ Sauria (Lizards)
- ☐ Crocodylia (Crocodilians)
- ☐ AVES (Birds)
- ☐ Passeriformes (Passerines)
- ☐ MAMMALIA
- ☐ Monotremata (Platypus, Echidna)
- ☐ Marsupalia (Marsupials)
- ☐ Eutheria (Placentals)
- ☐ Insectivora (Hedgehogs, Moles, Shrews, Tenrec, etc.)
- ☐ Chiroptera (Bats)
- ☐ Primates
- ☐ Humans
- ☐ Rodentia
- ☐ Lagomorphs (Rabbits, Hares, Pikas)
- ☐ Carnivora (Bears, Canids, Felids, Mustelids, Viverrids, Hyena, Procyonids)
- ☐ Perissodactyla (Odd-toed Ungulates) (Horses, Rhinos, Tapirs, etc.)

☐ Artiodactyla (Even-toed Ungulates) (Cattle, Sheep, Deer, Pigs, etc.) ☐ Marine Mammals (Seals, Walrus, Whales, Otters, Dolphins, Porpoises)	☐ TRANSGENIC ORGANISMS ☐ FOSSIL OR EXTINCT ORGANISMS	☐ NO ORGANISMS

CATEGORY VIII: MODEL ORGANISM (Select ONE)

☑ NO MODEL ORGANISM MODEL ORGANISM (Choose from the list)	☐ Escherichia coli ☐ Mouse-Ear Cress (Arabidopsis thaliana)	☐ Fruitfly (Drosophila melanogaster)

PROJECT SUMMARY

Overview:

The primary roles of the Long Term Ecological Research Network (LTER) National Communications Office (LNCO) are to ?foster and coordinate research, education, and outreach activities across the Network as well as facilitate Network governance??and to ?promote the LTER program both nationally and internationally? (NSF Program Solicitation 15-535). This proposal presents a vision for a cost-effective, forward-looking LNCO operated at the National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara, California. The LNCO is conceived as an integrated set of activities in three areas - Communication and Outreach, Synthesis Research, and Education and Training (Figure 1) ? that build on NCEAS' longstanding relationship with LTER scientists, leverage existing staff capacity and infrastructure, and take advantage of UCSB?s considerable strengths and resources in ecology, environmental science and management, science education, and environmental communication and media.

Intellectual Merit :

Project goals for communication and outreach are to cultivate relationships and synthetic team science within the LTER community, broaden engagements between the LTER community and other researchers and stakeholders outside the network, and disseminate LTER scientific discoveries, policy- and management-relevant knowledge to targeted audiences. Specific activities include an effective and engaging web presence featuring online research forums, multi-media research highlights, and access to tools and services that build awareness and participation in the LTER Network. To contain costs the LNCO will employ graduate students in the Strategic Environmental Communications and Media (SECM) Program at the Bren School of Environmental Science and Management, and will leverage the science communication and education resources of OCTOS (Outreach, Communication, & Training for Ocean Science), a new state-of-the-art facility in environmental communications and media on the UCSB campus.

The LNCO will identify, leverage, and deploy resources to maximize opportunities for synthesis across the LTER network. Synthesis working groups (SWG) and distributed graduate seminars (DGS) will be supported by experienced NCEAS staff and modern cyberinfrastructure. LNCO personnel will coordinate with the current LTER Network Office, with which NCEAS has close working relations, to achieve seamless data and information sharing. Topics for SWGs and DGS will be identified through annual calls for proposals and review by LTER leadership and independent science advisers. Additional networking will be supported through the triennial All Scientists Meeting (ASM), annual "mini-ASMs" held in conjunction with other professional meetings, and promotion and enabling of virtual LTER network interactions and team science.

Proposed LNCO activities to support LTER education and training efforts are organized into three areas: 1) Training, 2) Information Sharing, and 3) Partnerships and Exchanges. In-person and virtual training will focus on science communication and environmental media, collaboration skills, and graduate/early-career training in open synthesis science. The LNCO will support the LTER Education Committee and act as an information hub for education activities of the LTER Network on topics such as best practices, evaluation metrics and tools for student tracking. It will help identify and cultivate new partners for LTER education and training efforts, including the National Ecological Observatory Network (NEON). To encourage and promote diversity, the LNCO will work with the LTER Education Committee and Ecological Society of America's SEEDS program to support collaborations and disseminate information on funding, mentoring and training opportunities across the LTER network.

Broader Impacts :

Through its programs and activities, the LNCO will seek to encourage and promote diversity in its education and training, scientific synthesis, and communication and outreach activities. Taken as a whole, the LNCO will support the LTER community through a framework of scientific synthesis that facilitates more collaborative, integrative, transdisciplinary research, and though communication, education and training efforts that strengthen both internal and external relationships to expand awareness and impact of the LTER Network.

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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Project Description

Overview

The need for, and modes of science communication are changing rapidly because of ongoing dramatic transformations related to global environmental change, human demographic trends, and the widespread digital nature of communication and networking. These extraordinary transitions require that science communication from and within the Long Term Ecological Research (LTER) Network becomes more modern, agile, and responsive to an increasingly diverse and younger population. The new speed of both communication and scientific discovery demands that the LTER Network has cutting edge capabilities to interact, share information, synthesize data, and collaborate in all areas of research, communication, and education, both within and outside of the Network. We propose to solve these 21st Century challenges through an innovative arrangement that co-locates the LTER National Communications Office (LNCO) with the National Center for Ecological Analysis and Synthesis (NCEAS). This complementary and robust relationship will leverage expertise, resources, and technology to expand the capabilities of the LNCO and LTER Network as a whole.

The LTER Network's mission is "to provide the scientific community, policy makers, and society with the knowledge and predictive understanding necessary to conserve, protect, and manage the nation's ecosystems, their biodiversity, and the services they provide" (http://www.lternet.edu/node/20; accessed Apr 3, 2015). Implicit in this mission is the LTER's commitment to the "use of long-term observations and experiments to generate and test ecological theory at local to regional scales." [1] While each LTER site contributes to the ecological understanding of specific habitats, LTER's unique strengths emerge from being a network of cooperating and coordinated field sites that, collectively, can accelerate understanding of critical ecological processes and ecosystem services at regional if not global-scales. We believe the LTER National Communications Office (LNCO) should be the linchpin that galvanizes and nourishes the Network.

The mission of the LTER National Communications Office (LNCO) is to "foster and coordinate research, education, and outreach activities across the Network as well as facilitate Network governance" and to "promote the LTER program both nationally and internationally" through centralized representation (NSF 15-535). We envision the LNCO as an integrated set of activities in three areas - Communication and Outreach, Synthesis Research, and Education and Training (Figure 1). We propose that the LNCO can increase LTER's effectiveness as a Network by pursuing the scientific vision and directives put forth by the Executive and Science Councils; by fostering enhanced communication, collaboration, synthesis, training, and engagement amongst all the LTER and International LTER (ILTER) sites; and by representing and integrating the LTER Network more broadly with the rest of the scientific community and other stakeholders. We will accomplish this by creating and supporting services that take maximal advantage of recent technological innovations and are informed by emerging socio-cultural insights into strategies for effective communication and for enabling creative collaborative research.

There are many compelling reasons to operate the LNCO at NCEAS:

1. LTER scientists have always played a large role at NCEAS as working group participants, sabbatical fellows, postdoctoral fellows, and members of our Science Advisory Board. Thus we will initiate the LNCO with a strong, positive relationship with the LTER community that we seek to serve.
2. For the past 20 years NCEAS has served the ecological research community by providing an effective, 'neutral,' and hospitable physical meeting environment; a highly-trained service-oriented staff for logistical and technical support; and a suite of Internet-based collaboration tools and services to help catalyze new syntheses and transdisciplinary insights.[2]
3. NCEAS has extensive expertise in eco-informatics theory and practice, critical to supporting open, collaborative science and synthesis research.
4. NCEAS has staff trained and knowledgeable in meeting facilitation, scientific communication, and other aspects of the "science of team science" that optimize the composition, fluidity, and outcomes of its sponsored collaborative activities. This capacity will ensure excellent support of LTER

governance activities as well as research and training.

5. By leveraging the expertise and infrastructure that NCEAS already has in place to meet the mission of the LNCO, we can focus a relatively large fraction of the operating budget to sponsor productive synthesis, training, communications and outreach activities to raise the LTER Network's visibility and impact.
6. Every year 500-1000 researchers visit NCEAS. One-third are international scientists and an increasingly large fraction is from public agencies, environmental NGO's and the private sector. By locating at NCEAS, the LNCO will provide both the LTER and the ILTER communities with added exposure and opportunity to connect with a broadened base of collaborators and potential funding sources.
7. As a research unit of the University of California, Santa Barbara (UCSB), NCEAS can access the campus's considerable expertise in ecology, environmental science (both natural and social sciences), and education and communication, notably in UCSB's rapidly expanding area of environmental media and communication.

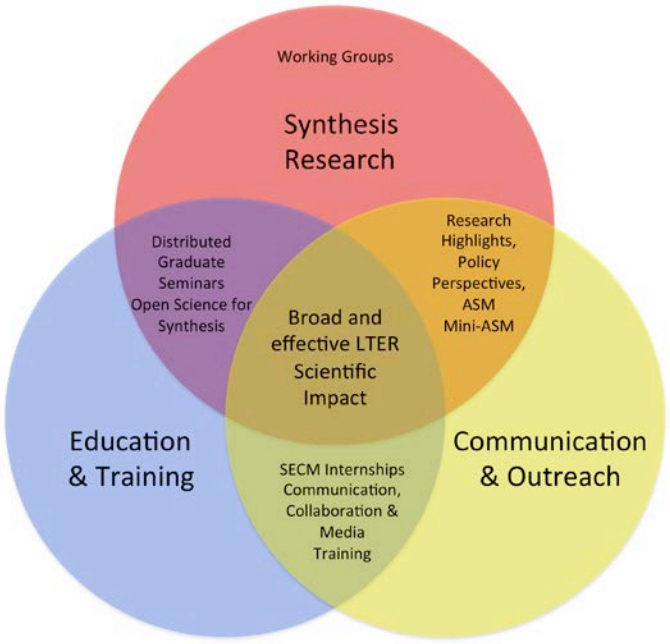

Figure 1. Overview of proposed LTER National Communication Office activities

Below we describe our proposed activities for a new LNCO in areas of: (1) communications and outreach, (2) synthesis, (3) education and training and (4) governance.

Amplifying LTER Communications and Outreach

A recent LTER Task Force examining network-level activities identified communication and outreach as critical components of the network as it moves forward.[3] We believe that effective communication for the LTER network will depend on deliberative targeting, framing, branding, and relationship-building.[4] The LNCO cannot simply "push out" information but needs to institute mechanisms that promote dialogue and interaction among the research community and between LTER researchers and other constituencies.[5]

Branding. The LNCO will conduct a comprehensive media assessment to better understand LTER Network visibility, current perceptions of its attributes and unique features, and how it stands out in an increasingly competitive environment for stakeholder and public attention. Building on NCEAS' familiarity with the science communications landscape, this assessment will give us an opportunity to

clarify and/or differentiate the LTER/ILTER Network as a unique and important research enterprise, prior to embarking on the communication and outreach efforts described below.

Shining the Spotlight. We propose to develop LTER Research Highlights - multi-media productions, similar in concept to "science spotlights" discussed in the LTER Strategic Communication Plan[6]- that will feature selected LTER research projects and discoveries. The target audience for the Highlights will be an educated lay audience or researchers from outside the discipline. The AGU's Research Spotlights (https://eos.org/research-spotlights) and London School of Economics' Research Impacts (www.lse.ac.uk/researchandexpertise/researchimpact) illustrate the type of product we envision, although we will aim for more video and audio content. Components developed for each Research Highlight will include an interesting story arc, a text description that clearly articulates "why you should care about this research," one or more high-quality photos, data visualization(s), short (3 minutes or less) high-quality video clips, and discussion forum. Links will be provided to primary research products such as papers, datasets, source code, and information about reuse of the materials.

We anticipate developing at least one Research Highlight every two years for each LTER site as well as for synthesis projects and distributed graduate seminars (described below). This will require production of 1-2 Research Highlights per month. The LNCO will coordinate collection, editing, and final packaging of these materials, but will rely on expertise at individual LTER sites to provide source materials and review much of the content. Key to success will be providing incentives for sites to contribute, and we will allocate resources and staff support accordingly. Information will be modularized for use in a variety of contexts such as web content for the research section of the LNCO website, for use by the featured site(s) as part of their own web content, content for annual reports, and content to be packaged as outreach materials targeted for media, educators and funders.

Community Building. We propose to establish web-based research forums to foster interactive community building. Initially, we would use Web 2.0+ frameworks to build an engaged, online community of researchers to share emerging ideas, data, and visualizations; and debate and discuss topics within and across each of the five core research themes of the LTER Network. Concerted effort will be made to involve at least one key participant from every site to keep these interactive discussion areas lively, timely, broadly representative, and attractive. Young researchers are especially enthusiastic about new social media hybrid solutions—e.g. following activities/events on Facebook - that are then promoted on Twitter, and enriched by imagery data from Instagram. We will build mashups based on existing frameworksn such as Drupal or Wordpress, with new affordances from semantic markup and dynamic, interactive infographics (e.g. using D3, GeoJSON, etc.) to create new collaboration prospects intended to more tightly co-inform and engage LTER researchers, as well as enable innovative views of "science-in-action" for broader interests.

Policy and Management Engagement. Long term ecological research can be especially valuable in guiding adaptive management and policy formulation.[7] An important goal of the LNCO will be to help individual sites and the network as a whole strengthen relationships with stakeholders such as managers, policymakers, educators, funders, media representatives, and citizen groups. While such relationships are widely recognized as valuable, effective communication between researchers and stakeholders is too often limited by lack of mechanisms and models for genuine engagement.[8] In recent years, NCEAS has significantly expanded our engagement with non-academic audiences through Science for Nature and People (SNAP) by including stakeholders in research planning efforts and working groups, providing project-specific stakeholder workshops, policy briefings, and other targeted outreach and communication efforts (www.snap.is).

We propose to assist LTER sites to expand their capacity to utilize a 'public engagement' or 'public participation' approach to outreach and communication. To work toward this goal, LNCO staff will collaborate with interested LTER sites to develop a process for capturing stakeholder perspectives on specific resource management issues through semi-structured interviews. Information gathered through pilot interviews will be used to develop issue-focused information products that feature multiple perspectives and highlight the importance and relevance of LTER research to planning, policy and

management issues and decision-making. We anticipate dissemination of these Perspectives pieces through similar channels to those used for the Research Highlights.

Online Discovery, Search and Browse. The LNCO will rely on an effective web presence as its primary mechanism for discovery and delivery of a number of useful LTER resources.[9] Here we mention a few high-priority LCNO web-based features and activities.

Information and multimedia content collected from LTER sites will be highlighted prominently on the LNCO website, and made searchable and browseable across a variety of parameters such as geographic region, biome, conceptual theme, methodological approach, LTER site, and personnel.

The current searchable directory (http://directory.lternet.edu) will be updated and re-worked to allow searches across multiple, joint categories (e.g., expertise category and site affiliation). We will take advantage of new tools such as Mappr (mappr.io) to advance networked science and help visualize networks of LTER expertise.

The LNCO website will use interactive visualizations and advanced search capabilities to make discovering and browsing publications resulting from LTER research more intuitive and engaging. The interactive visualization will be thematically organized based on text mining algorithms, and will allow filtering based on publication characteristics such as theme, LTER site, publication type, publication date, and author. This interactive web presentation of LTER publications will be modeled after a project currently underway to present NCEAS publications on the web (Figure 2). Each document is represented by a single dot in the center of the ring, and color corresponds to its main theme. Themes are also shown as a segmented ring surrounding the dots, and clicking on one segment of the ring filters the documents to show only those related to that theme. Mousing over the dot that corresponds to a document activates display of information about that document, and clicking on a dot loads a page with complete information for that document. Additional features under development allow filtering based on author, publication date, and document type.

LNCO staff will work with members of the LTER community who are interested in communicating with a variety of stakeholders to create descriptive profiles (or links to existing profiles) that will be integrated into a database and made searchable through the LNCO website. Profiles will include information about areas of expertise, biographical information, a photograph of the individual, photographs relevant to the individual's work, a short video during which the individual responds to an interview question, and links to other web content associated with this individual.

Social Media Amplification. We anticipate the LNCO website to be the primary venue for LNCO communication and outreach, but will also use a variety of social media platforms to reinforce the LTER brand, raise LTER network visibility, engage with a range of stakeholders, and amplify information dissemination efforts. The LNO communication staff will use chosen social media platforms to bring attention to events and information produced by partner organizations such as other research networks and scientific societies, and to share information that helps to build communities of interest around issues of relevance to LTER. We will also encourage LTER sites to begin to use social media to add their own voices to online conversations about issues of interest. Communication training opportunities offered by the LNCO will include elements focused on how to use social media to effectively engage with online communities.

Rewarding Excellence in Communication. To recognize the value of site-developed communication and education resources and media, the LNCO will present annual awards for excellence in these areas. The LNCO will announce the awards program and encourage LTER sites to nominate their own or their colleagues' communication, education and outreach products. Awards will be made by the LNCO, considering votes submitted by LTER network members.

Cost-effective communication. High quality communication demands both talent and resources. We will tap a broad talent pool and manage costs by partnering with two innovative new UCSB programs in environmental communication and media. Specifically, the LNCO will employ graduate students in the Strategic Environmental Communications and Media (SECM) Program at the Bren School of

Environmental Science and Management (www.bren.ucsb.edu/academics/secm_focus.htm). Students in this program acquire verbal and written communication skills and develop competence with web, video and social media tools; NCEAS currently employs 3-4 excellent SECM students for website re-design and content updates (www.nceas.ucsb.edu). The LNCO will also leverage the resources of OCTOS (Outreach, Communication, & Training for Ocean Science), a state-of-the-art facility for environmental science communication, media training and production under development at UCSB that is co-located with NOAA's Channel Islands National Marine Sanctuary Headquarters (www.msi.ucsb.edu/o2c).

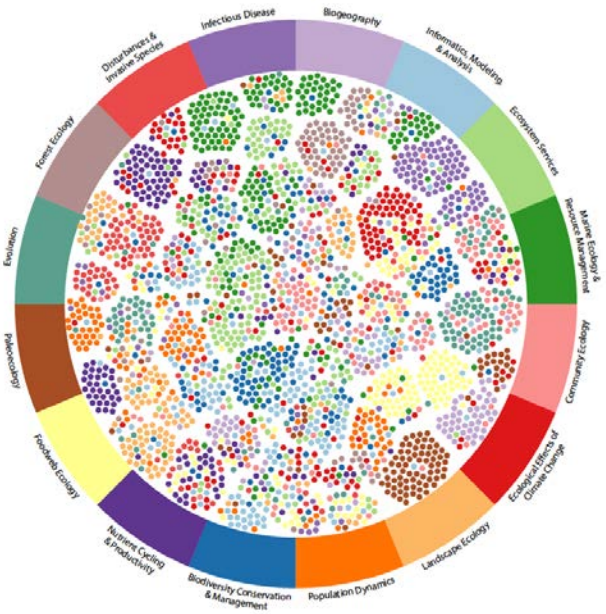

Figure 2. Screenshot of web-enabled interactive document browser currently under development at NCEAS.

Fostering Synthesis

Synthesis is the integration of disparate data and information to gain new knowledge and create more unified conceptual and empirical scientific structures.[12,13] As a key component of the LNCO's core responsibilities to foster communication and coordination among LTER sites, and to effectively represent and promote the LTER Network to external stakeholders, the LNCO will enable scientific synthesis among Network participants and beyond. Such synthesis activities will include both LTER data and other regional and national social and environmental data.

Co-locating LNCO with NCEAS will build on two decades of experience facilitating ecological synthesis. Over the years, dozens of NCEAS projects have involved hundreds of LTER researchers in the analysis and synthesis of LTER data, to gain understanding, for example, of the relationship between productivity and species' richness[12,13]; the links between evolutionary history, plant traits, community structure and ecosystem processes [14]; on detritus, trophic dynamics and biodiversity [15]; and on valuing and managing dynamic ecosystem services.[16]

To achieve this model of LTER synthesis, researchers must organize around a mutually compelling set of ideas and questions; disparate data and information need to be brought together and re-structured for new analyses; significant time must be invested in intense collaborative engagements; and, adequate resources must be committed for meetings, research assistance, publication, communication and outreach. The LNCO will assist in all aspects of this effort. Studies in the "science of team science" are now identifying the group dynamic features that lead to more effective and productive collaborative teams.[17,18,19] Like NCEAS, the LNCO will apply these lessons and promote diverse, collaborative, open, and

technologically informed research activities to catalyze synthesis. We will also provide training and focused communication and outreach to broaden the impact and social utility of the research (described below), and will take advantage of NCEAS partnerships such as SNAP to identify and leverage funds for cross-site syntheses and to broaden interactions with audiences such as NGOs and public agencies.

LTER Synthesis working groups (SWG). We propose to initiate at least two new LTER Synthesis Working Groups annually and thus support at least 4-6 active groups at any given time. Synthesis Working Groups provide excellent opportunities to bring together LTER scientists from multiple sites in sustained interaction. These interactions don't simply lead to high quality, integrative scientific insights; they also build trust, expand collaboration networks, and naturally lead to more compatible patterns in data design and shared, optimized use of computing resources. The LNCO will strive to assure that the SWG's abide by principles of "Open Science," permitting maximal re-usability and transparency of scientific outputs, including data and code, as well as research results.

A Synthesis Working Group would typically be composed of 6-14 collaborators from within and outside of LTER, who would convene at NCEAS for 3-5 days at a time, 2-3 times per year for 1-2 years.[20] LTER working groups will be identified by annual calls for proposals for synthesis research projects both within and across the 5 core LTER research areas. Projects will be selected by the LTER Executive Board (or a committee of the Board) augmented with 3-5 independent (non-LTER) researchers who will be appointed by the LNCO Director in consultation with the Board. Working groups will be provided adequate support for projects of up to 2 years duration. Funds could be used for participant costs, facilitator support of in-person and virtual interactions, and graduate student support, as funding allows. We will encourage proposals that take advantage of virtual collaboration tools as well as face-to-face meetings, and we will train working group leaders and participants in best practices for virtual collaboration (discussed below). We anticipate that many working group proposals will develop out of initial ad-hoc working group meetings held at the All Scientists Meeting (ASM) or "mini-ASM" timed around professional meetings such as ESA, AGU or AAAS (discussed below).

Distributed Graduate Seminars (DGS). We propose to annually support one NCEAS-style DGS[21] that will simultaneously engage and train next-generation ecologists in the analysis and synthesis of LTER and non-LTER data, stimulate cross-site collaboration and additional synthesis efforts, build value-added datasets, and advance ecological knowledge. Proposal co-PIs will lead seminars at their home campuses that address the question(s) developed in the proposal. Graduate students on each campus will participate in the individual seminars and assemble, synthesize and analyze LTER (and potentially non-LTER data). LNCO will provide virtual meeting and analysis facilities to stimulate remote collaboration across institutions as the seminars are conducted at each university. At the end of the seminar, seminar leaders and two students from each site will come to NCEAS to participate in a multi-campus "grand" analysis and synthesis effort.

DGS proposals will be funded through an annual call, and projects will be selected as described above for working groups. Funds will be used to support participant costs for faculty leaders and at least 2 students from each campus for a final synthesis working group meeting. DGS projects selected will pose compelling research questions, involve multiple LTER sites, and provide students with valuable experience in collaborative research and open synthesis science (https://www.nceas.ucsb.edu/OSS).

LNCO Support of LTER Synthesis. Both working groups and distributed graduate seminars will be provided the high level of logistical support, onsite meeting facilities and cyberinfrastructure that have been a hallmark of NCEAS' success over the past 20 years.[22] We will offer computing expertise and training in data management, scientific programming, data analysis and visualization, and open science. Working groups and DGS participants will also have access to NCEAS-sponsored virtual collaboration technologies such as "private" web-based project and issue tracking solutions (e.g. redmine.org), video teleconferencing with integrated screen-sharing and session archiving (e.g. GoToMeeting), as well to advanced computational servers that provide large memory spaces and multiple CPU's.

Coordination with LTER Data Management. NCEAS has partnered with the current LTER Network Office (LNO) for many years to help build technology solutions for managing and disseminating LTER data. Separation of the LNCO from the data management functions of the LNO places a special burden on the LNCO to collaborate closely with the LNO in research data and information sharing, coordination of training activities related to data management and open science skills, and transfer of relevant administrative databases (e.g., the LTER investigator database). NCEAS' computing personnel currently have close and continued engagement with the LNO IT team through collaborations on the NSF-sponsored DataONE project. We will maintain close working relationships with the LNO Data Office to assure seamless data and information sharing, and clear understanding of roles and responsibilities in training, communication and outreach.

Organizing the LTER All Scientists Meeting (ASM). The LNO Task Force found that the triennial ASM meeting was an important mechanism for introducing new collaborators, early-career scientists and students to the LTER network, and for promoting cross-site research and synthesis.[3] The Task Force recommended that the ASM continue to be one of the central services of the LNCO. We will assume the LTER Network Office's current role in the ASM on a triennial basis, starting with the Fall 2018 meeting, with the objective of facilitating researcher interactions and stimulating new collaborative networks and synthesis working groups. We will work to ensure that the triennial meeting best serves the LTER community by gathering feedback from the community on how to best structure the meeting for maximum impact. In addition, with reductions in funding to the sites for participation in the meeting, it is likely that fewer participants will be able to physically attend. We will utilize live streaming and other social media outlets (e.g. twitter, instagram) to make the meeting accessible online.

Other engagements to facilitate synthesis. Given the large resources needed to stage the ASM we do not think it is feasible or desirable to increase its frequency; however, building and maintaining relationships among LTER researchers would benefit by additional meetings to plan, continue or report back on synthesis activities, for training, and for information sharing. To that end, we propose to organize at least one "mini-ASM" annually in conjunction with one of the large scientific society meetings (e.g. Ecological Society of America, Association for the Sciences of Limnology and Oceanography, American Geophysical Union) in years when the ASM is not being held. These meetings would be one full day in duration immediately before or following the start of the society meetings and would likely be focused on advancing synthesis efforts among a group of LTER scientists that would be attending any particular meeting. The LNCO will provide the meeting facility and assist in promoting the meeting, communicating the agenda, and providing technical and logistical support during the meeting. Participant costs (travel, lodging, per diem) would be covered by the participants.

Promoting virtual interactions. Researchers in a wide variety of academic disciplines have documented the importance of communication to successful project outcomes [23], and have found that the quality and consistency of communication is especially important for cohesion and productivity of groups that are geographically dispersed.[24] Increased familiarity and greater social cohesiveness foster higher productivity for teams [25], and both social communication and task-related communication are important for establishing and maintaining trust between collaborators [26]. The LNCO will promote and support virtual interaction technologies and approaches to support synthesis, education, and training activities across the LTER network.

Successful implementation of virtual interaction systems relies on accurate evaluation of communication and interaction needs, selection of appropriate technical equipment and software to meet those needs, and participation of individuals who possess relevant expertise.[19] Such expertise includes not only proficiency in the technical operation of virtual interaction systems, but also knowledge of systems and skills for leading, facilitating, and participating in virtual interactions and teams. To increase use and effectiveness of virtual interaction across the LTER network we will first undertake a network-wide evaluation of communication and collaboration needs, technical readiness, existing technical and organizational expertise and practices, and attitudes toward increased use of virtual communication technologies. Based upon the outcomes of this formative assessment, which will be completed in Year 1, we will develop a

plan for supporting virtual communication and collaboration both within the LTER network and with external collaborators and stakeholders. Possible virtual solutions include application of a range of technologies (e.g., telepresence, videoconferencing, project management software, collaborative brainstorming and decision-making tools, multimedia and social media) with distinct groups of users in a variety of contexts. Once implementation of appropriate virtual interaction systems has begun (Year 2), the LNCO will lead ongoing evaluation and user feedback from the community. This feedback will help us optimize the use of virtual collaboration technologies across the network, and coordinate documentation and communication of scientific, environmental, and diversity benefits associated with increased use of virtual interaction.

Building Education and Training Capacity across the LTER Community

Education plays a key role in the LTER because of the need to train the next generation of environmental scientists, engage the general public about ecosystem services, and communicate with the public about the nature and value of scientific research. The Strategic Plan for Education in the LTER Network promotes a vision of an environmentally literate citizenry able to make informed choices about complex environmental issues.[1] Achieving this vision will require strategic initiatives to (1) develop leadership, organization, and cyber-infrastructure, (2) promote research and development around our goals of environmental science literacy and inclusion of diverse people and perspectives, and (3) develop programs for specific constituent groups: graduate and undergraduate students and professors K- 12 teachers and administrators, and diverse communities of active citizens.

Current LTER education and outreach efforts are summarized in Appendix A. Here we focus on activities that can be undertaken at the LNCO to support LTER education and outreach programs. These activities are organized into three main areas: 1) Training, 2) Information Sharing, and 3) Partnerships and Exchanges.

Training. One of the primary ways that the LNCO can help the LTER achieve its vision for Education is by building capacity across the LTER community in skills ranging from technical skills for open synthesis science, to digital media production to effective science communication. LNCO will build on NCEAS experience and success in these areas (www.nceas.ucsb.edu/training). LNCO training and workshops will be offered virtually, as well as in-person in conjunction with ASM and mini-ASM meetings, through opportunities that are coordinated with Synthesis Working Groups and Distributed Graduate Seminars, or at national meetings. Focal topics include:

1. Science Communication and Environmental Media training. The LNCO will offer high-impact short-term communication-training workshops as frequently as at least one per year. The subjects of communication workshops will range from strategies for communicating with media and policymakers to techniques for creating and editing multimedia communication materials and data visualizations for engaging a wide range of audiences. Digital media are playing an ever-increasing role in education. Scientists and graduate students are finding new ways to 'storytell' using digital media, and short 'anchor videos' have become popular in the classroom as a way to introduce and engage student learners. LTER sites may be interested in using such techniques to produce 'Digital Field Trips' for students, visitors and others who may be interested in site activities. To build capacity within the LTER network to use communication and education tools and techniques, LNCO will provide short workshops at meetings as well as online communication and media training opportunities. Online training in environmental media will be modeled after the SciFund Challenge (www.scifundchallenge.org) online class, "Video Outreach for Scientists 101," which provides some content via website and interactive modules using Google+.
2. Collaboration skills. It is increasingly evident that group dynamics can be optimized through the acquisition of particular skills and sensitivities for which researchers typically receive little or no direct training. Based on recent insights into the "science of team science", the LNCO will provide training to all Working Group leaders in facilitation methods for both remote and face-to-

face collaboration that offer more pleasant, productive, and equitable experiences for participants in our synthesis activities.

3. Environmental Media Training. Digital media is playing an ever-increasing role in education. Short videos (called 'anchor videos') have become popular in the classroom as a way to introduce and engage student learners. Scientists and graduate students are finding new ways to 'storytell' using digital media. For example, LTER sites may be interested in producing "Digital Field Trips" for students, visitors and others who may be interested in site activities. We will provide training to LTER students, staff and researchers in the production of short videos, podcasts and other digital forms.
4. Open Science for Synthesis (OSS). In 2013 and 2014 NCEAS offered training for early career scientists who wanted to learn new software and technology skills needed for open, collaborative, and reproducible synthesis research (https://www.nceas.ucsb.edu/OSS). These summer institutes were extremely successful and we are using the experience to develop scalable training modules and mini-courses. The LNCO will work with our OSS collaborators to provide online and onsite training opportunities for LTER early career scientists in topics such as data management, preservation, and sharing; data manipulation, integration, and exploration; scientific workflows and reproducible research; agile and sustainable software practices; and, data analysis and modeling.

Education and Public Participation. The LNCO will act as an information exchange hub to coordinate and share information on a variety of topics related to education including best practices, evaluation metrics, and tools for student tracking. The LNCO will provide direct support to the Education committee, facilitate coordination across the committee, and provide mechanisms to share information between the Education Committee and the broader LTER network. The LNCO will seek funding resources for education and outreach at individual sites and across the Network and assist with grant writing for cross-site education initiatives. Recent educational developments have provided new opportunities for the LTER to make significant contributions to formal and informal environmental science education at levels ranging from preschool to adult learners. Below we highlight two of these areas, and the role of the LNCO in strengthening the contributions of the LTER in these areas:

- Most states have now adopted the new Common Core State Standards (CCSS), a set of high-quality academic standards in mathematics and English language arts (ELA) (corestandards.org). In addition to the CCSS, most states have also adopted the Next Generation Science Standards (NGSS) as a complementary set of learning goals in the domain of science (nextgenscience.org).[27] Many teachers and school administrators are eager to find opportunities to engage their students in activities and experiences that are aligned with these new standards. The LNCO can greatly assist the LTER Education Committee in coordinating, aligning and disseminating educational resources and opportunities that are well-suited to these new standards. Additionally the LNCO may serve as a unifying entity for the ongoing teacher professional development programs across the LTER network, and integrate these efforts with the RET opportunities and exchanges.
- The incorporation of Public Participation in Scientific Research (PPSR)[28] has become widely recognized as an invaluable way to generate scientific knowledge, motivate public engagement with scientific research and advocacy, and provide education about scientific subject matter.[29] A common form of PPSR is the citizen science programs that seek to document and conserve biological diversity or to assess ecological responses to anthropogenic stressors[29,30] Achieving the full potential of citizen science requires collaboration among programs and professional scientists to bridge local data with-large scale research objectives. The LTER network is uniquely situated to provide a framework for the incorporation of citizen science programs to meet educational objectives, and to increase the scope of long-term and large-scale data collection. The LNCO can help to facilitate the coordination of citizen science efforts within, across and beyond the LTER network to address core large-scale research questions.

The LNCO will support the continuing efforts of the LTER Education Committee to expand the LTER Education Digital Library (LEDL), a centrally located collection of reviewed and annotated digital educational resources that have been developed by LTER researchers, educators and partners. This growing collection includes demonstrations, static visualizations, animations and simulations, videos, podcasts, webinars, photographs, curriculum modules, data nuggets, long term data sets, citizen science protocols, experiments and educational posters. The library incorporates metadata that also allows the LTER collection to be harvested by other digital libraries to broaden the collective efforts of the LTER Educational program.

Partnerships and Exchanges. We will continue to seek partners to expand the scope and reach of the LTER Education efforts. The partnership with CLEAN Pathways Project (cleanet.org) for the review and distribution of LTER education resources is an excellent example of the strength of partnerships in expanding the reach of the LTER Education program. Graduate students and researchers at Niwot Ridge LTER are working with ScienceLIVE (sciencelive.org) to create cutting-edge curriculum based on the site's data on climate, hydrology and ecology. The lesson plans help teachers make use of real datasets and encourage students to interact with active research projects through live research updates and interactive web resources. This partnership streamlines researcher involvement in outreach and increases the reach and impact of outreach activities. We will explore this model, as well as others, to assess appropriateness and feasibility for the creation of educational resources at other LTER sites.

All of the LTER sites involve graduate and undergraduate students in their research programs, and some sites also support Research Experiences for Teachers (RET) teachers as well. Several LTER sites have developed highly successful exchange programs across sites for these students and teachers. In these exchanges teachers, for example, may spend one summer at a particular LTER site focused in a topic area, then move to another LTER site the following year to continue to explore the topic within a different ecosystem. The LNCO can contribute to the a high level of coordination and communication needed for these exchanges to be successful. On behalf of the LTER Network, the LNCO will maintain close communications with other major ecologically relevant information and resource discovery frameworks, such as the National Ecological Observatory Network, NEON (http://neoninc.org); and the Data Observation Network for Earth, DataONE (http://dataone.org). NCEAS currently has strong connections with both NEON and DataONE through its Informatics Research and Development Team, in particular its Director Matthew Jones. Our Communication and Education team similarly has ongoing connections with counterparts at NEON and DataONE. As new LTER Network-relevant institutions and services emerge, the LNCO will investigate and where appropriate, forge new connections and partnerships to enhance both inward and outward-facing capabilities for LTER researchers, and more generally, for the scientific community.

Encouraging and Promoting Diversity

Dramatic variation in the nature and scope of human-environment interactions arises from the diverse needs, perspectives, values and goals of people around the world. This diversity in human thought and action means that contributions from individuals of all cultural, ethnic, and economic backgrounds are critical to producing ecological understanding that can inform decisions about how to manage global human-environment interactions.

Despite educators' efforts to recruit and retain underrepresented students in the environmental sciences, survey results have indicated that ecology in particular has among the lowest proportions of underrepresented students and professionals of any science.[31] The LTER network is well positioned to employ key strategies for promoting diversity in ecology and the environmental sciences[32-34,36, 37] through programs that offer increased funding opportunities, provide more effective mentoring, and make hands-on research opportunities more accessible. The LNCO will help to streamline partnerships and ongoing collaboration between LTER Education committee leaders and ESA's SEEDS program, and emerging collaborations with the Society for Advancement of Chicanos and Native Americans in Science (SACNAS), various community college consortia, and the American Indian Science and Engineering Society (AISES), The LNCO will also provide networking opportunities that strengthen the connections

among mentors and mentees through time, thereby fostering development of ‘mentorship ladders’ that provide critical academic support systems for students from groups traditionally underrepresented in the sciences.[33] The LNCO will assist LTER and I-LTER sites with coordination of research internships and student exchanges and recruitment of underrepresented populations to participate in these programs, which provide premiere opportunities for authentic hands-on research experiences.

Strategies to promote diversity will also be incorporated in the synthesis research activities coordinated by the LNCO. LNCO staff will broadly disseminate information about these opportunities and contact potential participants directly to encourage application. LNCO staff will seek to enhance the benefits of diverse participation by offering collaboration and facilitation training activities that include strategies to support equitable participation by all members in group discussions and decision-making processes. Formative and summative evaluation will provide information about whether the LNCO is achieving desired levels of participation by underrepresented groups, and the degree to which participants feel that their perspectives are heard in group processes and represented in final products produced by the group.

Communication and outreach programs and products will prioritize communication with diverse audiences. Care will be taken to ensure that identified stakeholder groups for public engagement with LTER network research encompass diverse and underrepresented groups. Furthermore, LNCO communication staff will maximize the diversity of the group of researchers, educators, students and other stakeholders featured in LNCO-developed communication and outreach materials such as Research Highlights, Perspectives, and environmental media products.

Support of LTER Governance

The LNCO will assume the current Network Office's role of supporting LTER Network Governance by facilitating meetings of the LTER Executive Board, Annual Science Council and Executive Committee meetings, as well as meetings of selected LTER Committees such as the LTER Site Information Managers and the Education and Outreach Committee. The Executive Board currently meets annually at NSF in conjunction with an LTER mini-symposium, for one day before the annual Science Council meeting, once every 3 years at the ASM, and via conference calls approximately monthly at other times.

At their current size and frequency LTER governance meetings consume a considerable fraction of the LNCO effort and annual budget. We will work with NSF Program Directors and LTER leadership to explore ways to reduce costs, maximize the cost-effectiveness of LTER leadership meetings, and make maximal appropriate use of virtual meetings.

Formative and Summative Evaluation of the LNCO

Given the LNCO's mission and objectives, evaluation will be "utilization-focused."[34,35] By this we mean evaluation with specific primary users of the evaluation in mind. We consider this group to be first and foremost LNCO personnel, NSF program officers, and LTER leadership (Executive Board and Science Council). Essentially, these constituents need to know whether LNCO activities are having the effects that LNCO designed them to have, are meeting NSF needs and expectations, and are serving the needs of the LTER community. LNCO leadership and activity coordinators will work together to prioritize evaluation efforts among our goals for Communication and Outreach, Scientific Synthesis, Education and Training, and Supporting Network Governance, with an eye to generating evaluation results that can be used to improve programs. We will seek to unify LNCO evaluation efforts to make collection of the necessary data as efficient and unobtrusive for LTER participants as possible.

We will develop an explicit evaluation policy initially modeled after that of the National Institute for Mathematical and Biological Synthesis (NIMBioS), which includes policy for both formative and summative evaluations, describes the types of information being gathered, assures adherence to evaluation standards such as those promulgated by the American Evaluation Standards, and complies with university policies regarding human subjects, survey design and privacy (www.nimbios.org/governance/NIMBioSEvaluationPolicy.pdf).

Formative evaluation will proceed during the granting period to collect and analyze data from participants related to satisfaction, knowledge gain, and research network development, as well as suggestions for

improvement. In particular, we will focus on needs and capacity for virtual collaboration, effectiveness of training in open synthesis science, and efficacy of communication and outreach. Education and training effectiveness will be evaluated through a combination of online surveys and interviews. To evaluate communication and outreach efforts, we will use stakeholder surveys, interviews, bibliometric and network analyses. Website analytics[36] will be used to examine how web resources (e.g., research highlights, researcher and resource databases, multimedia communication products) are being used, who is using them, and how visitors arrive at and navigate through the site.

Summative evaluation will include many of the same elements included in formative evaluation, as well as information on performance indicators such as the number and type of synthesis activities, number and diversity of researchers and students involved in synthesis efforts, activity costs, research products and outcomes, new proposals developed and funds procured to support LTER synthesis research. We will explore the use of alternative metrics, particularly for evaluating broader research impacts, using tools such as ImpactStory (www.altmetrics.org).

The LNCO will track basic indicators related to the environmental impact of our programs (e.g., greenhouse gas emissions), and will use this information to establish targets for reducing impact.

Broader Impacts of the Proposed Work

Taken as a whole, the LNCO will support the LTER community through a framework of scientific synthesis that facilitates more collaborative, integrative, transdisciplinary research, and though communication, education and training efforts that strengthen both internal and external relationships to expand awareness and impact of the LTER Network by funding agencies, educators, policy and decision makers. Training efforts will positively impact under-represented groups in ecology and environmental science by coordinating efforts and opportunities across the LTER Network.

LNCO Management Plan

Organizational structure

NCEAS already has much of the expertise and cyberinfrastructure in place to operate the LNCO. The center is currently funded through extramural contract and grants, the State of California, and UCSB. We are a stand-alone research unit under UCSB's Office of Research with authority to administer contracts and grants. Figure 3 shows the current NCEAS Organization Structure with the proposed inclusion of the LNCO.

Figure 3 is useful for displaying lines of authority, but in practice NCEAS is a small, horizontally integrated operation in which teams organize around specific functions. For example, working group support involves teamwork by staff in accounting, travel coordination, computing, and communication. We envision that the LNCO will be integrated into this team-based environment as opposed to operating as a stand-alone unit. For example, LNCO Communications will be led by a new Communications and Outreach Coordinator supported by 3-4 graduate interns from the Bren School's SECM Program, with further assistance from existing NCEAS communication and web programming staff.

Personnel

LNCO PI Davis will have primary authority and responsibility for the LNCO's successful operation and will liaise with LTER leadership and NSF to ensure that LTER needs from the LNCO are prioritized and met. Davis served as founding NCEAS Deputy Director from 1995 to 1998 and has directed NCEAS since 2011. Davis is experienced in long term ecological research, co-leading a 15-year, large scale field oak recruitment experiment[37], serving for a decade as faculty manager of the UC Sedgwick Reserve, and conducting research at several other field research stations including the Konza Prairie LTER[38,39] and, as part of an ongoing Macrosystems Biology Project, at San Joaquin Experimental Range (a NEON core site).[40]

NCEAS communications and outreach activities are currently directed by NCEAS Director of Programs LeeAnne French with support from Software Designer Lauren Walker, Analyst Debbie Donahue, and 3-4 part-time graduate interns from the Bren School of Environmental Science and Management

(www.bren.ucsb.edu). This team designs and populates the NCEAS website (www.nceas.ucsb.edu), issues regular communications to the NCEAS subscriber list, prepares annual reports, and designs and produces collateral materials. The team also partners with TNC and WCS to maintain the Science for Nature and People (SNAP) website (www.snap.is) and various SNAP communications. To operate the LNCO, we will add a full-time, dedicated LTER Communications and Outreach Coordinator (to be named) and 3-4 additional communications interns, with support provided as needed by our current communications and outreach personnel. The Communications and Outreach Coordinator will be a communications professional who will have or develop close familiarity with the LTER network, serve as the point of contact for LTER scientists and key stakeholders, supervise communications and outreach staff and interns, and work with NCEAS leadership to ensure that all communication and outreach functions of the LNCO are operating efficiently and effectively.

Co-PI Carol Blanchette will lead LNCO Education and Training activities. Dr. Blanchette has extensive experience in long-term ecological research in marine and freshwater ecosystems. As co-director of education at the UCSB Marine Science Institute, she leads the development of science communication and education programs at OCTOS. As the SBC-LTER co-leader of the cross-LTER Math Science Partnership "Pathways to Environmental Literacy" project, she has been deeply involved in LTER network education and outreach. She will be responsible for coordinating LTER education and training, leading teacher-training activities, and contributing to communication and outreach materials.

Co-PI Jennifer Caselle will work with LTER leadership to coordinate LNCO synthesis research activities and to evaluate those activities. Dr. Caselle is a research biologist at UCSB and PI of the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), with extensive experience in long term ecological research and participation in NCEAS working groups.

Co-PI and NCEAS Associate Stacy Rebich-Hespanha will oversee development of LNCO evaluation programs, and will take a leading role in design and evaluation of network development, virtual collaboration, and stakeholder engagement activities. Dr. Rebich-Hespanha's research interests include design, analysis and visualization of environmental information, tools and approaches for virtual collaboration, research policy and culture, and the science of environmental communication.

Co-PI Mark Schildhauer, NCEAS Director of Computing at NCEAS, will be responsible for coordinating with the LTER Network Office and overseeing computing support of LNCO activities. An expert in environmental informatics, Dr. Schildhauer has worked extensively with LTER scientists and the LTER Network office for two decades and is engaged in a number of national and international efforts to improve environmental data accessibility and interpretability.

Senior Personnel Matt Jones, NCEAS Director of Informatics Research and Development, will oversee development and use of informatics tools to support LNCO website search capabilities, synthesis efforts, and training in open science for synthesis.

Consultant and NCEAS Associate Jai Ranganathan is a conservation biologist whose work is increasingly focused on the use of social media and online venues for science communication, public engagement in science, and communication training. The co-founder of SciFund Challenge (http://scifundchallenge.org) and #Scifund University (http://scifundchallenge.org/scifund-university/university-curriculum/), Dr. Ranganathan will work with LNCO staff to develop and evaluate communication and outreach strategies, online training courses and website functionality.

NCEAS staff includes experienced professionals in office management and business services, contracts and grants administration, meeting and travel planning, communications and outreach, scientific computing, and environmental informatics (Figure 3). These existing NCEAS staff members will assume the administrative tasks of the LNCO. We will ensure that NCEAS' experienced core staff transfer other work responsibilities as needed to provide excellent support of the LNCO, and will use non-LNCO funds to add new staff as needed to meet other NCEAS programmatic demands.

Facilities, Equipment, and Other Resources

Computational resources and network

High performance computing is available on a 48-node, 32-node, and several 16-node clusters, for demanding modeling, statistical, visualization, and data management projects. Access to a 1024-node system on the UCSB campus is also available. Systems are all running 64-bit OSes loaded with state-of-the-art scientific software, and access to storage arrays with aggregate holding capacity in the low-hundreds of terabytes. Connectivity with Internet2 is available through a dedicated 100Mbps link. NCEAS has a number of desktop systems and laptops installed with custom scientific software and internet connectivity available for researchers to use during their visit. Meeting preparation and archival support are available through several web-based collaboration solutions, including code-versioning repositories (subversion; git), issue-tracking software (redmine and bugzilla), Wikis (various) and content-management systems (Plone, Drupal).

Conferencing space and breakout offices

NCEAS houses a state-of-the-art scientific research and conferencing facility, that includes ample meeting space for one-two meetings of 25 persons and an array of collaboration devices, including numerous high-resolution data projectors, smart-boards, and large LED panels. Participants have access to advanced scientific programming expertise in the use of NCEAS' systems, as well as dedicated desktop support personnel. NCEAS provides the facilities, equipment, and staff support to promote the analysis and synthesis of ecological and environmental information. NCEAS is located in the heart of downtown Santa Barbara, with a congenial climate year-round and highly convenient access to a number of amenities relative to dining and off-hours outdoor recreation and cultural entertainment.

Results from Prior NSF Support

PI Davis. NSF #DBI-0553768, National Center for Ecological Analysis and Synthesis, 2006-2013, $18,402,599, Frank Davis and Stephanie Hampton (PIs).

NSF supported NCEAS from 1995 until 2013, the final two years on a no-cost extension basis, during which time Davis served as PI. Since 1995, NCEAS has engaged more than 6000 scientists and experts from 57 countries in Working Group collaborations, supported more than 525 Projects proposed by the science community, and published more than 2,300 peer-reviewed scientific articles. Between 2010 and 2013 NSF-supported activities at NCEAS included 85 projects (working groups, distributed graduate seminars, postdoctoral fellowships, and sabbatical fellows). To date, those projects have produced 4 books, 3 book chapters, 628 journal articles, and 54 public datasets. A complete listing of NCEAS publications is available at the NCEAS website, https://www.nceas.ucsb.edu/products.

Co-PI Schildhauer. NSF #OCI- 0830944, DataONE , $19,999,742, 2009-2014, W. Michener, S. Hampton, M. Schildhauer, T. Vision, A. Cook, M. Jones, C. Vieglais, et al., co-PIs. Schildhauer led the Data Integration and Semantics working group, which is extending concepts from the KNB to span software repository platforms and provides for system interoperability across data repositories, virtually centralized data discovery, machine-accessible data and metadata across repositories, and a suite of investigator soft-ware tools that cover the full data lifecycle (e.g., DMPTool, DataUp, Morpho, and the DataONE R client).[41]

Co-PI Carol Blanchette. #1220359, Ocean Acidification – Collaborative Research: OMEGAS II - Linking ecological and organismal responses to the ocean acidification seascape in the California Current System, $320,491, 10/1/12-9/30/15, G. Hofmann (PI), L. Washburn and C. Blanchette (Co-PIs). This project expands and strengthens the existing oceanographic network to increase our understanding of the coastal ocean acidification regime, providing the environmental context for ecological and physiological research. Results to date indicate that global change variables could have additive effects that exceed thresholds for optimized physiological performance in keystone marine species such as purple sea urchins (*Strongylocentrotus purpuratus*).[42,43,44]

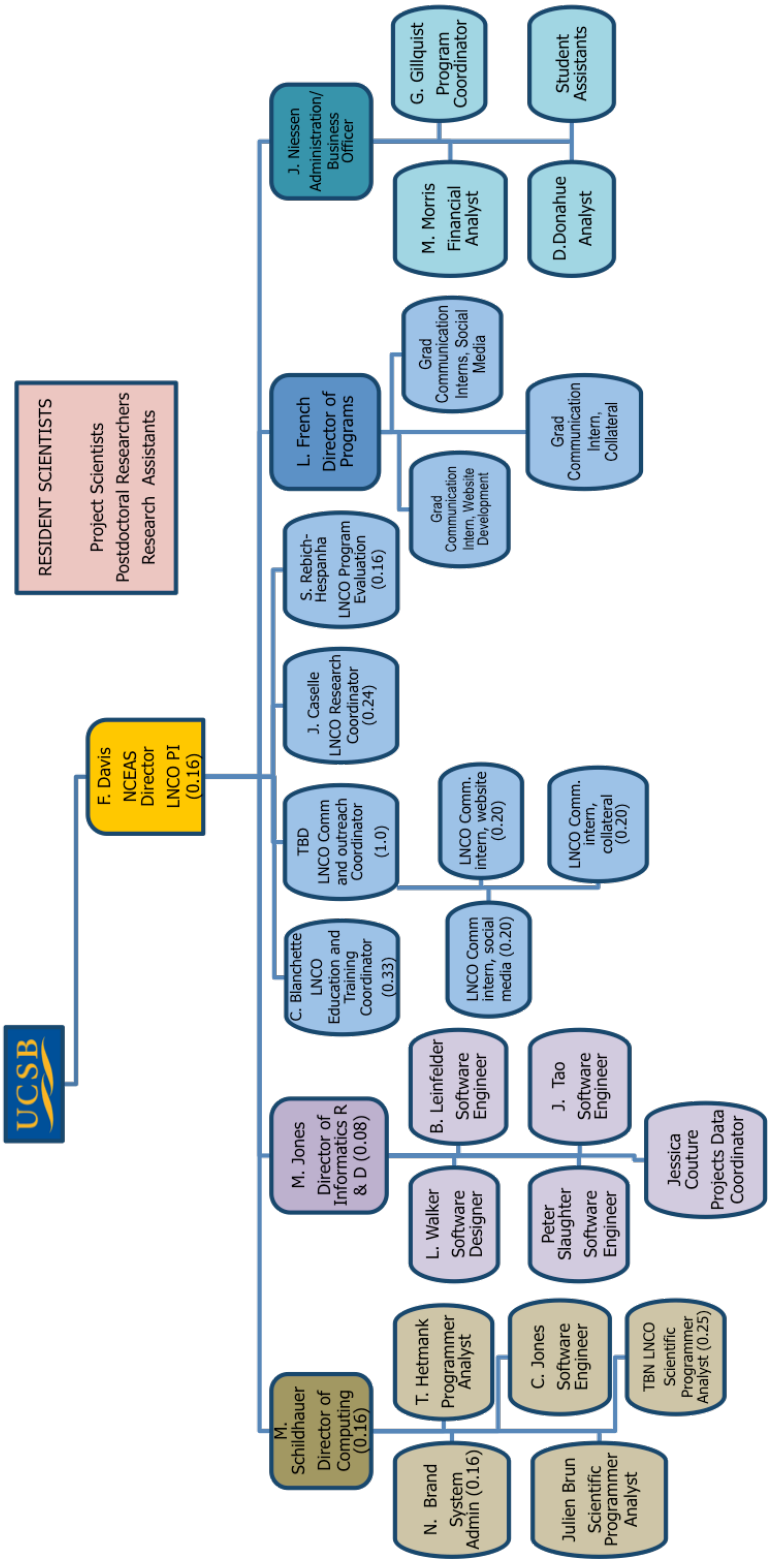

Figure 3. Proposed organizational structure for co-locating LNCO with NCEAS. Numbers in parentheses indicate fraction of individual's time supported by LNCO funds.

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30. Dickinson, J. L., Zuckerberg, B. & Bonter, D. N. Citizen Science as an Ecological Research Tool: Challenges and Benefits. *Annu. Rev. Ecol. Evol. Syst.* **41,** 149–172 (2010).
31. Lawrence, D.M., Holland, M. & Morrin, D. Profiles of ecologists: results of a survey of the membership of the Ecological Society of America. Part I. A snapshot of survey respondents. *Bull. Ecol. Soc. Am.* 21–35 (1993).
32. Organization for Tropical Studies. *Advisory Committee for Academic Diversity Manual of Best Practices for Recruiting and Retaining Underrepresented Groups in Ecology and the Environmental Sciences*. (2007).
33. Hunt, D. M. & Michael, C. Mentorship: A Career Training and Development Tool. *Acad. Manage. Rev.* **8,** 475–485 (1983).
34. Patton, M. Q. *Essentials of utilization-focused evaluation*. (SAGE, 2012).
35. Campbell, C. A., Lefroy, E. C., Caddy-Retalic, S., Bax, N., Doherty, P. J., Douglas, M. M., Johnson, D., Possingham, H. P., Specht, A., Tarte, D. & West, J. Designing environmental research for impact. *Sci. Total Environ.* (2015). doi:10.1016/j.scitotenv.2014.11.089
36. Chiou, W.-C., Lin, C.-C. & Perng, C. A strategic framework for website evaluation based on a review of the literature from 1995–2006. *Inf. Manage.* **47,** 282–290 (2010).
37. Davis, F. W., Tyler, C. M. & Mahall, B. E. Consumer control of oak demography in a Mediterranean-climate savanna. *Ecosphere* **2,** art108 (2011).
38. Davis, F. W., Schimel, D. S., Friedl, M. A., Michaelsen, J. C., Kittel, T. G. F., Dubayah, R. & Dozier, J. Covariance of biophysical data with digital topographic and land use maps over the FIFE site. *J. Geophys. Res.-Atmospheres* **97,** 19009–19021 (1992).
39. Michaelsen, J., Schimel, D. S., Friedl, M. A., Davis, F. W. & Dubayah, R. C. Regression Tree Analysis of Satellite and Terrain Data to Guide Vegetation Sampling and Surveys. *J. Veg. Sci.* **5,** 673–686 (1994).
40. Dingman, J. R., Sweet, L. C., McCullough, I., Davis, F. W., Flint, A., Franklin, J. & Flint, L. E. Cross-scale modeling of surface temperature and tree seedling establishment in mountain landscapes. *Ecol. Process.* **2,** 1–15 (2013).
41. Michener, W. K. & Jones, M. B. Ecoinformatics: supporting ecology as a data-intensive science. *Trends Ecol. Evol.* **27,** 85–93 (2012).

42. Hofmann, G., Blanchette, C., Rivest, E. & Kapsenberg, L. Taking the Pulse of Marine Ecosystems: The Importance of Coupling Long-Term Physical and Biological Observations in the Context of Global Change Biology. *Oceanography* **26,** 140–148 (2013).
43. Padilla-Gamino, J. L., Kelly, M. W., Evans, T. G. & Hofmann, G. E. Temperature and CO2 additively regulate physiology, morphology and genomic responses of larval sea urchins, Strongylocentrotus purpuratus. *Proc. R. Soc. B Biol. Sci.* **280,** 20130155–20130155 (2013).
44. Kelly, M. W., Padilla-Gamiño, J. L. & Hofmann, G. E. Natural variation and the capacity to adapt to ocean acidification in the keystone sea urchin *Strongylocentrotus purpuratus*. *Glob. Change Biol.* **19,** 2536–2546 (2013).

BIOGRAPHICAL SKETCH

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Research Lab URL: http://www.biogeog.ucsb.edu

Professional Preparation

Williams College	Biology	B.A., 1975
The Johns Hopkins University	Geography and Environmental Engineering	Ph.D., 1982

Academic/Professional Appointments

2011-present: Director, National Center for Ecological Analysis and Synthesis, UCSB
1996-present: Professor, Bren School of Environmental Science and Management, UCSB
1995-1998: Deputy Director, National Center for Ecological Analysis and Synthesis, UCSB
1994-present: Professor, Department of Geography, UCSB.
1989-1994: Associate Professor, Department of Geography, UCSB
1983-1989: Assistant Professor, Department of Geography, University of California, Santa Barbara

Research Products

Most closely related to the proposed project

Dingman, J., L. Sweet, **F.W. Davis**, J. Franklin, A. Flint, and L. Flint. Cross-scale modeling of surface temperature and seedling establishment to improve projections of tree distribution shifts under climate change. *Ecological Processes* 2:30.

Davis, F. W., C. M. Tyler, and B. E. Mahall. 2011. Consumer control of oak demography in a Mediterranean-climate savanna. *Ecosphere* 2(10):108. doi:10.1890/ES11-00187.1

Friedl, M. A., **F. W. Davis**, J. Michaelsen, and M. Moritz. Scaling and uncertainty in the relationship between LAI and NDVI: an analysis using a scene simulation model and data from FIFE. *Remote Sensing of Environment* 54: 233-246.

Sork, V.L., **F. W. Davis**, P. Smouse, V. Apsit, R. Dyer, J. Fernandez, W. Kuhn. 2002. Pollen movement in declining populations of California valley oak, *Quercus lobata*: Where have all the fathers gone? *Molecular Ecology* 11: 1657-1668.

Odion, D. C. and **F.W. Davis**. 2001. Fire, soil heating, and the formation of vegetation patterns in chaparral. *Ecological Monographs* 70: 149–169.

Other products

Chornesky, E.A., D.D. Ackerly, P. Beier, **F.W. Davis**, L.E. Flint, J.J. Lawler, P.B. Moyle, M. A. Moritz, M. Scoonover, K, Byrd,P. Alvarez, N.E. Heller, E.R. Micheli, and S.B. Weiss. 2015. Adapting California's ecosystems to a changing climate. *Bioscience* 65: 247-262.

Franklin, J., **F.W. Davis**, M. Ikegami, A.D. Syphard, L.E. Flint, A.L. Flint, and L. Hannah. 2013. Modeling plant species distributions under future climates: how fine scale do climate projections need to be? *Global Change Biology* 19:473-483.

Davis, F.W., M. Borchert, R. K. Meentemeyer, A. Flint and D. M. Rizzo. 2010. Pre-impact forest composition and ongoing tree mortality associated with sudden oak death in the Big Sur region; California. *Forest Ecology and Management* 259: 2342-2354.

Davis, F.W., C. Costello and D. Stoms. 2006. Efficient Conservation in a Utility-Maximization Framework. *Ecology and Society* 11 (1): 33. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art33/

Scott, J.M., **F. W. Davis**, G. McGhie, C. Groves. 2003. Nature reserves: do they capture the full range of America's biological diversity? *Ecological Applications* 11: 9999 – 1004.

Synergistic Activities

2001: Aldo Leopold Leadership Fellow
Member, Board of Trustees, The Nature Conservancy of California, since June 2004
Chair, National Research Council Committee for the Independent Scientific Review of the Everglades Restoration Program, 2009-2010
Member, National Research Council Committee on Science for EPA's Future, 2011-2012
Chair, National Research Council Committee on Effective Approaches for Monitoring and Assessing Gulf of Mexico Restoration Activities, since 2015

Collaborators and Other Affiliations

Co-authors and Co-Editors (60)

David Ackerly (UC Berkeley), William Anderegg (Princeton U.), Dennis Baldocchi (UC Berkeley), Jill Baron (USGS), Paul Beier (N. Arizona U.), Joseph Berry (Stanford U.), Kristin Bird (USGS), Mark Borchert (USFS), Erin Boydsen (USGS), Liz Chornesky (Independent consultant), Kevin Crooks (Colorado State U.), Stephanie Dashiell (Defenders of Wildlife), John Dingman (California Energy Commission), Brian Dolan (UCLA), Thomas Dunn (UCSB), Christopher Field (Stanford U.), Lorraine Flint (USGS), Alan Flint (USGS), Janet Franklin (ASU), Roland Geyer (UCSB), Dale Goble (U. Idaho), Robin Grossinger (San Francisco Estuary Institute), Alex Hall (UCLA), Stephanie Hampton (Washington State U.), Lee Hannah (Conservation International), Makihiko Ikegami (Lincoln U., New Zealand), Patrick Jantz (Woods Hole Research Center), Mark Jenner (UC Davis), Steve Kaffka (UC Davis), Jon Keeley (USGS), Jason Kreitler (USGS), Josh Lawler (U. of Washington), Jan Lindner (U. Stuttgart), Lynn Maguire (Duke U.), Bruce Mahall (UCSB), Ian McCullough (UCSB), Ross Meentemeyer (UNC Charlotte), Vicky Meretsky (Indiana U.), Kurt Merg (Washington State Fish and Wildlife), Max Moritz (UC Berkeley), Peter Moyle (UC Davis), Theresa Nogeire (Colorado State U.) , Jeanette Papp (UCLA), Kelly Redmond (Desert Research Institute), Helen Regan (UC Riverside), David Rizzo (UC Davis), J.Michael Scott (U. Idaho), Pep Serra-Diaz (Arizona State U.), Rebecca Shaw (Environmental Defense Fund), Peter Smouse (Rutgers U.), Oliver Soong(UCSB), Victoria Sork (UCLA), David Stoms (California Energy Commission), Lynn Sweet (UCSB), Alexandra Syphard (Conservation Biology Institute), Claudia Tyler (UCSB), Lorena Vieli (UCSB), Hong Wang (UCLA), Robert Westfall (USFS), Allison Whipple (San Francisco Estuary Institute), Bastian Wittstock (U. Stuttgart)

Graduate Advisor (1): Grace S. Brush

Graduate Advisees and Postdoctoral Scholars, past 5 years

Ph.D. Advisees (7)
Patrick Jantz (Woods Hole Research Center)
Jason Kreitler (USGS)
Bill Kuhn (National Park Service)
Theresa Nogeire (U. of Washington)
Lorena Vieli (Universidad de la Frontera)
Oliver Soong (In progress)
Ian McCullough (In progress)

Postdoctoral Scholars (3)
Maki Ikegami (U. New South Wales)
Lynn Sweet (UCSB)
John Dingman (USGS)

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PROFESSIONAL PREPARATION

University Of Notre Dame,	Notre Dame, IN,	Biology,	B.S. 1988
Oregon State University,	Corvallis, OR,	Zoology,	PhD 1994
Stanford University, Postdoctoral Fellow,	Palo Alto, CA.	Biomechanics,	1994 -1995
University Of California, Postdoctoral Fellow,	Santa Barbara, CA,	Marine Science,	1995-1999

ACADEMIC APPOINTMENTS

2000 - present	Associate Research Biologist, University of California, Santa Barbara
1997 - 2000	Instructor, University of California, Santa Barbara, CA
1995 - 1996	Instructor, Oregon State University, Corvallis, OR

RELEVANT PUBLICATIONS

1. Hofmann, G.E., T. G. Evans, M.W. Kelly, J. L. Padilla-Gamiño, C. A. Blanchette, L. Washburn, F. Chan, M. A. McManus, B. A. Menge, B. Gaylord, T. M. Hill, E. Sanford, M. LaVigne, J.M. Rose, L. Kapsenberg, and J. M. Dutton. 2013. **Exploring local adaptation and the ocean acidification seascape - studies in the California Current Large Marine Ecosystem**. *Biogeosciences* 10:11825-11856.
2. Hofmann, G.E., Carol A. Blanchette, Emily B. Rivest, and Lydia Kapsenberg. 2013. **Taking the pulse of marine ecosystems: The importance of coupling long-term physical and biological observations in the context of global change biology**. *Oceanography* 26(3):140–148.
3. Blanchette, C.A., D.R. Schiel, E.A. Wieters, B.R. Broitman, and B.P. Kinlan. 2009. **Trophic structure and diversity in rocky intertidal upwelling ecosystems: A comparison of community patterns across California, Chile, South Africa and New Zealand** *Progress in Oceanogprahy 83:107-116.*
4. Blanchette, C.A., C.M. Miner, P.T. Raimondi, D. Lohse, K.E.K. Heady, and B.R. Broitman. 2008. **Biogeographic patterns of rocky intertidal communities along the Pacific coast of North America** *Journal of Biogeography* 35:1593-1607.
5. Pfister, C.A., AJ Esbaugh, CA Frieder, H Baumann, EE Bockmon, MM White, BR Carter, HM Benway, CA Blanchette, E Carrington, JB McClintock, DC McCorkle, WR McGillis, TA Mooney, P Ziveri. 2014. **Detecting the Unexpected: A Research Framework for Ocean Acidification.** *Environmental science & technology 48 (17) 9982-9994.*

OTHER SIGNIFICANT PUBLICATIONS

1. Helmuth, Brian, Chris Harley, Patti Halpin, Michael O'Donnell, Gretchen E. Hofmann, and Carol Blanchette. 2002. **Climate change and latitudinal patterns of intertidal thermal stress: Is life always hotter, south of the border?** *Science* 298:1015-1017.
2. Broitman, B.R., L. Szathmary, K.A.S. Mislan, C.A. Blanchette, and B. Helmuth. 2009. **Predator-prey interactions under climate change: the importance of habitat vs.body temperature** *Oikos 118:219-224*
3. Reed, D.C., S.J. Holbrook, C.A. Blanchette and S. Worcester. 2009. **Patterns and sources of variation in flowering, seed supply, and seedling recruitment in surfgrass *Phyllospadix torreyi*** *Marine Ecology Progress Series 384:97-106*
4. Mislan, K.A.S., Carol A. Blanchette, Bernardo R. Broitman, and Libe Washburn. 2011. **Spatial variability of emergence, splash, surge, and submergence in wave-exposed rocky-shore ecosystems** *Limnology and Oceanogprahy 56(3):857-866.*
5. Watson, JR, CG Hays, PT Raimondi, S Mitarai, C Dong, JC McWilliams, CA Blanchette, JE Caselle, DA Siegel. 2011. **Currents connecting communities: nearshore community similarity and ocean circulation** *Ecology 92(6):1193-1200.*

SYNERGISTIC ACTIVITIES

Santa Barbara Coastal (SBC) LTER Co-Director of Education
Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) Principal Investigator
Ocean Margins Ecosystem Group for Acidification Studies (OMEGAS) Principal Investigator
Science Panel of MARINE (Multi-Agency Rocky Intertidal NEtwork)
Biodiversity Strand Leader of NSF-sponsored Math Science Partnership Project
UCSB Marine Science Institute, Director of Education and Outreach

COLLABORATORS & OTHER AFFILIATIONS Collaborators And Co-Editors (65 totoal)
Barth, Jack (Oregon State University), Baumann, Hannes (University of Connecticut), Benway, Heather (Woods Hole Oceanographic Institution), Bockmon, Emily (University of California, San Diego), Broitman, Bernardo (Universidad Católica del Norte), Brose, Ulrich (Georg-August-University Goettingen), Bukel, Christine (NOAA Center for Coastal Fisheries and Habitat Research), Burnaford, Jennifer (California State University, Fullerton), Bursek, Julie (Channel Islands National Marine Sanctuary), Carr, Mark (University of California Santa Cruz), Carrington, Emily (University of Washington), Carter, Brendan (Princeton University), Caselle, Jennifer (University of California Santa Barbara), Chan, Francis (Oregon State University), Chavez, Francisco (Monterey Bay Aquarium Research Institute), Cheriton, Olivia (University of California Santa Cruz), Denny, Mark (Stanford University), Dutton, Jessica (University of California Santa Barbara), Engle, Jack (University of California, Santa Barbara), Esbaugh, Andrew (University of Texas), Evans, Tyler (University of California Santa Barbara), Frieder, Christina (University of Southern California), Friederich, Gernot (Monterey Bay Aquarium Research Institute), Gaines, Steven (University of California Santa Barbara), Gaitán-Espitia, Juan Diego (UniversidadAustraldeChile), Gaylord, Brian (University of California Davis), Gouthier, Tarik (Northeastern University), Hancock, Joshua (University of California, Santa Barbara), Helmuth, Brian (University of South Carolina), Hill, Tessa (University of California Davis), Hofmann, Gretchen (University of California Santa Barbara), Isles, Alison (Oregon State University), Kapsenberg, Lydia (University of California Santa Barbara), Kefi, Sonia (Georg-August-University Goettingen), Kelly, Morgan (University of California Santa Barbara), Lafferty, Kevin (USGS Western Ecological Research Center), LaVigne, Michelle (Oregon State University), Lubchenco, Jane (Oregon State University), McClintock, James (University of Alabama), McCorkle, Daniel (Woods Hole Oceanographic Institution), McGillis, Wade (Lamont-Doherty Earth Observatory), McManus, Margaret (University of Hawaii), Menge, Bruce (Oregon State University), Miller, Luke (Stanford University), Mislan, Allison (Princeton University), Mooney, T. Aran (Woods Hole Oceanographic Institution), Navarrette, Sergio (Universidad Catolica, Chile), Nielsen, Karina (Sonoma State University), O'Donnell, Michael (University of Washington), Padilla-Gamino, Jacqueline (University of California, Santa Barbara), Palumbi, Steve (Stanford University), Petchey, Owen (University of Sheffield), Pfister, Catherine (University of Chicago), Raimondi, Peter (University of California Santa Cruz), Reed, Daniel (University of California Santa Barbara), Rivest, Emily (University of California, Davis), Rose, Jeremy (Oregon State University), Russell, Ann (University of California Davis), Sanford, Eric (University of California Davis), Smith, Jayson (Cal Poly Pomona), Warner, Robert (University of California Santa Barbara), Washburn, Libe (University of California Santa Barbara), Whitaker, Steven (Channel Islands National Park), White, Meredith (Bigelow Laboratory for Ocean Sciences), Ziveri, Patrizia (Vrije Universiteit Amsterdam)

Graduate Advisors and Postdoctoral Sponsors
Lubchenco, Jane and Menge, Bruce (Graduate Advisors, Oregon State University), Denny, Mark (Postdoctoral Sponsor, Stanford University), Gaines, Steve (Postdoctoral Sponsor, University of California Santa Barbara), Reed, Daniel (Postdoctoral Sponsor, University of California Santa Barbara)

Thesis Advisor and Postgraduate-Scholar Sponsor
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PROFESSIONAL PREPARATION

University of California, Berkeley.	Zoology	B.S.	1987
University of California, Santa Barbara.	Marine Ecology	Ph.D.	1997

PROFESSIONAL APPOINTMENTS

Associate Research Biologist and Lecturer, University of California, Santa Barbara 2006-present
Assistant Research Biologist, University of California, Santa Barbara 1999-2006
Resident Postdoctoral Associate, Wrigley Institute of Environmental Studies (Catalina Island), University of Southern California 1998.
Postdoctoral Researcher, University of California, Santa Barbara 1997-1999

5 MOST RELEVANT PUBLICATIONS (TOTAL = 62)

Hamilton, S.L and J.E. Caselle. 2015. Exploitation and recovery of size structure of a sea urchin predator has implications for the resilience of southern California kelp forests. *Proceedings of the Royal Society B.* 282: 20141817. http://dx.doi.org/10.1098/rspb.2014.1817

Botsford, L.W., J.W. White, M.H. Carr and J.E. Caselle. 2014. Marine protected area networks in California, USA. *Advances in Marine Biology*. 69: 205-251. http://dx.doi.org/10.1016/B978-0-12-800214-8.00006-2

Grorud-Colvert, K., J. Claudet, B.N. Tissot, J.E. Caselle, M.H. Carr, J.C. Day, A.M. Friedlander, S.E. Lester, T. Lison de Loma, D. Malone and W.J. Walsh. 2014. Marine protected area networks: Assessing whether the whole is greater than the sum of its parts? *PLoS ONE 9(8): e102298. doi:10.1371/journal.pone.0102298*

Hamilton, S.L., Newsome, S.D. and J.E. Caselle. 2014. Niche expansion of a kelp forest predator recovering from intense commercial exploitation. *Ecology*. 95:164-172. http://dx.doi.org/10.1890/13-0014.1

Beas-Luna, R., M. Novak, M. Carr, T. Tinker, A. Black, J.E. Caselle, M. Hoban, D. Malone and A. Iles. 2014. An online database for informing ecological network models: http://kelpforest.ucsc.edu. *PloS ONE*. 9(10): e109356. doi:10.1371/journal.pone.0109356

5 OTHER PUBLICATIONS

Hamilton S.L, J.E. Caselle, D. Malone, and M.H. Carr. 2010. Incorporating biogeography into evaluations of the Channel Islands marine reserve network. *Proceedings of the National Academy of Sciences USA.* 107: 18272-18277. [doi/10.1073/pnas.0908091107]

Leis, J.M., J.E. Caselle, I.R. Bradbury, T. Kristiansen, J. K. Llopiz, M.J. Miller, M.I. O'Connor, C.B. Paris, A.L. Shanks, S.M. Sogard, S.E. Swearer, E. A. Treml, R.D. Vetter, R.R. Warner. 2013. Does fish larval dispersal differ between high and low latitudes? *Proc R Soc B* 280: 20130327. http://dx.doi.org/10.1098/rspb.2013.0327

Caselle, J.E., B.P. Kinlan, and R.R. Warner. 2010. Temporal and spatial scales of influence on near-shore fish recruitment in the Southern California Bight. *Bulletin of Marine Science*. 86:355-385

Caselle, J.E., S.L. Hamilton, D.M. Schroeder, M.S. Love, J.D. Standish, J.A. Rosales-Casian, and O. Sosa-Nishizaki. 2011. Geographic variation in density, demography, and life history traits of a harvested temperate sex-changing reef fish. *Canadian Journal of Fisheries and Aquatic Sciences.* 68:288-303.

Caselle, J.E. 1999. Density-dependent early post-settlement mortality in a coral reef fish and its effect on local population size. *Ecological Monographs*. 69:177-194.

SYNERGISTIC ACTIVITIES

PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans): Co-PI in the establishment of a large-scale, long-term ecological consortium with goals of understanding nearshore ecosystem dynamics in the California Current system; development of scientific basis for marine reserves; training students and postdocs skilled in interdisciplinary study of marine ecosystem dynamics and marine conservation; rapid transference of knowledge to management and policymakers; networking with NGOs, agencies (see http://www.piscoweb.org).

PARC (Palmyra Atoll Research Consortium); co-founded consortium dedicated to advancing science and conservation of coral reefs. Currently Executive Director of PARC. PARC is a collaborative partnership of universities, museums, conservation organizations and federal agencies that conducts innovative, interdisciplinary work on the natural systems of Palmyra Atoll and the central Pacific.

California Marine Protected Area Monitoring integration: leadership role in developing statewide monitoring program for CA MPAs. Worked with large group of funded PIs on data integration and synthesis.

Advisory Board for California State MPA watch citizen science program

Recent Collaborators. Not including individuals at UCSB and those listed above in publications.
TOTAL = 59
Barth, J. (OSU), Ballesteros, E. (CEAB-CSIC Spain), Bernardi, G. (UCSC), Botsford, L. (UC Davis), Chan, F. (OSU), Chapman, D. (SUNY-Stony Brook), Claisse, J. (Occidental), Erzini, K. (Algarve Univ), Goldman, K. (Alaska Fisheries), Goncalves, E. (Instituto Superior de Psicologia Aplicada, Portugal), Gosnell, S. (SUNY), Hamilton, S. (MLML), Long, D. (Cal Academy), Lowe, C. (CSU Long Beach), McManus, M. (Univ Hawaii), Menge, B. (OSU), Newsome, S. (U.New Mexico), Novak, M. (OSU), Palumbi, S. (Stanford), Papastamatiou, Y. (Univ. Florida), Pondella, D. (Occidental), Raimondi, R. (UCSC), Sandin, S. (SIO), Sala, E. (Nat Geo), Tinker, T. (UCSC and USGS), Watanabe, Y (Polar Inst Japan), Weng, K. (VIMS), White, J. (UNC), Williams, G. (SIO), Woodson, C. (Georgia)

Graduate Students/Postdoctoral Students Supervised
Svedlund, C. (UCSB), Topping, D. (CSU Long Beach), Belquist, L. (CSU Long Beach), Graves M. (CSU San Francisco), Wilson, J. (Cal Poly San Luis Obispo and UCSB), Horta e Costa, B. (Instituto Superior de Psicologia Aplicada, Portugal) Davis, K. (UCSB), Carlson, P. (UCSB), Freedman, R. (UCSB)

Postdoctoral Students Supervised
Readdie, M. (UCSB and UCSC), Vilas, C. (UCSB), Shears, N. (UCSB). S. Hamilton (UCSB).

Graduate Advisors and Postdoctoral Sponsors
Robert Warner (PhD advisor), Peter Sale (PhD comm.), Steve Gaines (PhD Comm), Roger Nisbet (PhD Comm), Milton Love (Post doc sponsor).

Stacy Rebich Hespanha

(a) Professional preparation

University of Pennsylvania	Philadelphia, PA	Biological Basis of Behavior	B.S. 1996
UC Santa Barbara	Santa Barbara, CA	Geography	M.A. 2005
UC Santa Barbara	Santa Barbara, CA	Geography (Emphasis in Cognitive Science)	Ph.D. 2011
UC Santa Barbara	Santa Barbara, CA	Natl Ctr for Ecological Analysis & Synthesis	2011-2014

(b) Appointments

Assistant Researcher, 2014 – present. National Center for Ecological Analysis and Synthesis and Earth Research Institute, UC Santa Barbara

Postdoctoral Scholar, 2011 – 2014. National Center for Ecological Analysis and Synthesis, UC Santa Barbara

Education and Outreach Coordinator, 2011 – 2012. UC Center for Environmental Implications of Nanotechnology, UC Santa Barbara

Acting Education and Outreach Coordinator, 2011. Center for Nanotechnology in Society, UC Santa Barbara

(c) Products

(i) related to proposed project

1) S. Rebich Hespanha, S.M. Menz, J. Bragg, B. Beamer, *DataONE Data Stories*, https://www.dataone.org/data-stories, (2015).

2) S. Rebich Hespanha, K. Scheidemen, A. Martin, S. Rider, *Evaluation and visualization of thematic foci in UCSB Earth Research Institute publications and projects, 2009-2014*, prepared for ERI External Review, October 9-10, 2014, http://www.eri.ucsb.edu/sites/www.eri.ucsb.edu/files/20141008ERIposter.pdf.

3) S. Rebich Hespanha, V. Hutchison, H. Henkel, *Report on Evaluation of DataONE Data Management Short Course (May 23-24, 2012) and CEE Data Management Education Lessons*, DataONE Community Engagement and Education Working Group, http://www.dataone.org/sites/all/documents/ShortCourseReport2012.pdf, (2013).

4) S.I. Fabrikant, S. Rebich Hespanha, M. Hegarty, Cognitively adequate and perceptually salient graphic displays for efficient spatial inference making, *Annals of the Association of American Geographers, 100*: 1-17 (2010).

5) D.G. Janelle, S. Rebich Hespanha, F. Goodchild, M.F. Goodchild, CSISS Workshops and National Dissemination of Geographic Analysis in the Social Sciences, *Journal of Geography in Higher Education, 33*: S88-S103 (2009).

(ii) other significant products

1) S. Rebich Hespanha, R.E. Rice, D.R. Montello, S. Retzloff, S. Tien, J.P. Hespanha, Image themes and frames in U.S. print news stories about climate change, *Environmental Communication*, http://www.tandfonline.com/doi/abs/10.1080/17524032.2014.983534 (2014).

2) S. Rebich Hespanha, Thematic and affective content in textual and visual communication about climate change: Historical overview of mass media sources and empirical investigation of emotional responses, Doctoral dissertation available via ProQuest or at http://goo.gl/W4Yg6 (2011).

3) S. Rebich Hespanha and João Hespanha. Text Visualization Toolbox — a MATLAB toolbox to visualize large corpus of documents. Available at http://www.ece.ucsb.edu/~hespanha/software/textvistools.html, (2010-2015).

4) S. Rebich Hespanha, F. Goodchild, D.G. Janelle, Spatial thinking and technologies in the undergraduate social science classroom, Journal of Geography in Higher Education, 33: S17-S27 (2009).

5) S. Rebich, C. Gautier, Concept mapping to reveal prior knowledge and conceptual change in a Mock Summit course on global climate change, Journal of Geoscience Education, 53: 355-365 (2005).

(d) Synergistic Activities

1) Data analysis and interactive visual design for web-based visual browser for NCEAS research projects and publications. Research themes and associated publications were identified based on topic modeling analysis of titles, abstracts, and keywords for all NCEAS research publications and project descriptions.
2) Leading assessment for pilot online course at UCSB. We used concept mapping to evaluate learning in an online course as part of the Online Pilot Program in Summer (OPPS) at UCSB.
3) Lead researcher on DataONE Data Stories project. Through structured interviews and focus groups, we are collecting stories from researchers related to their experiences with managing and sharing scientific research data. Narratives developed from these interviews are now available online (see Products related to proposed project), and analysis of the transcripts to identify common obstacles and sources of conflict in data management and sharing continues.
4) Collaborator on Advancing Theory and Research on Scientific Synthesis as part of NCEAS/NESCent working group. Using statistical natural language processing (topic modeling) and data visualization to identify evidence and patterns of synthesis in scientific publications. Preliminary results available via figshare: http://dx.doi.org/10.6084/m9.figshare.1314918
5) Literature review and manuscript preparation on the environmental costs of research travel. Focus is on the opportunities and challenges in using virtual interaction to reduce dependence on air travel.

(e) Collaborators in past 48 months & Other Affiliations (22)

Ben Adams, Centre for eResearch, University of Aukland
Jennifer K. Balch, Department of Geography, University of Colorado, Boulder
Amber Budden, DataONE, University of New Mexico
Jarrett Byrnes, Department of Biology, University of Massachusetts, Boston
Kathy Cottingham, Department of Biological Sciences, Dartmouth University
John Drake, Odum School of Ecology, University of Georgia
Catherine Gautier, Department of Geography, UC Santa Barbara
Sara Irina Fabrikant, Department of Geography, University of Zurich
Stephanie E. Hampton, Center for Environmental Research, Education & Outreach, Washington State Univ
João P. Hespanha, Department of Electrical and Computer Engineering, UC Santa Barbara
Vivian Hutchison, US Geological Survey
Erin Leahey, Department of Sociology, University of Arizona
Deborah McGuinness, Computer Science and Cognitive Science, Rensselaer Polytechnic Institute
Daniel R. Montello, Department of Geography, UC Santa Barbara
John Parker, Barrett the Honors College, Arizona State University
Ismael Rafols, Polytechnic University of València
Ronald E. Rice, Department of Communication and Carsey-Wolf Center, UC Santa Barbara
Mark Schildhauer, National Center for Ecological Analysis and Synthesis, UC Santa Barbara
Patrice Seyed, Rensselaer Polytechnic Institute and University of New Mexico
David Siegel, Earth Research Institute, UC Santa Barbara
Niki Vermeulen, Science Technology and Innovation Studies, University of Edinburgh
Todd Vision, National Evolutionary Science Center, UNC Chapel Hill

Graduate Advisors and Postdoctoral Sponsors (4)

Catherine Gautier, Department of Geography, UC Santa Barbara
Daniel R. Montello, Department of Geography, UC Santa Barbara
Stephanie E. Hampton, National Center for Ecological Analysis and Synthesis, UC Santa Barbara
Frank Davis, National Center for Ecological Analysis and Synthesis, UC Santa Barbara

Mark P. Schildhauer
National Center for Ecological Analysis and Synthesis E-mail: schild@nceas.ucsb.edu
735 State St., Suite 300 http://www.nceas.ucsb.edu/
Santa Barbara, CA 93101 Cell: (805) 886-9526

PROFESSIONAL PREPARATION

Harvard College	Biology	A.B., 1976
Univ of California, Santa Barbara	Ecology and Evolutionary Biology	Ph.D.,1991

APPOINTMENTS

1995 - present **Director of Computing**
National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara

1993 - 1995 **Computer Resource Manager and Technical Coordinator**
Division of Social Sciences, University of California Santa Barbara

1990 – 1993 **Programmer Analyst**
Social Sciences Computing Facility, University of California, Santa Barbara

1986-1989 **Ecological data analyst and laboratory computer coordinator**
Marine Sciences Institute, University of California Santa Barbara

PRODUCTS (most closely related)

Walls, RL,… **Schildhauer, M**…et al. 2014. Semantics in support of biodiversity knowledge discovery: an introduction to the biological collections ontology and related ontologies. PLoS ONE 01/2014; 9(3):e89606.

Cao, Huipeng, Shawn Bowers, **Mark P. Schildhauer**. 2012. Database support for enabling data-discovery queries over semantically-annotated observational data. *In:* Transactions on Large-scale Data- and Knowledge-Centered Systems VI; 01/2012.

Reichman, OJ, Jones MB, **Schildhauer MP**. 2011. Challenges and opportunities of open data in ecology. *Science* 331(6018):703-705.

Madin, Joshua S., Shawn Bowers, **Mark P. Schildhauer**, Matthew B. Jones. 2008. Advancing ecological research with ontologies. *Trends in Ecology & Evolution* vol. 23, issue 3, pp. 159-168.

Jones MB, **M Schildhauer**, OJ Reichman and S Bowers. 2006. The New Bioinformatics: integrating ecological data from the gene to the biosphere. *Annu Rev of Ecol, Evol, and System 37*, pp. 519-544.

PRODUCTS (other significant)

Borer, Elizabeth, Eric Seabloom, Matt Jones, **Mark P. Schildhauer**. 2009. Some simple guidelines for effective data management. *Bull Ecol Soc. America* vol. 90, issue 2, pp. 205-214.

Pennington, Deana D., William K. Michener, Samantha Katz, Laura L. Downey, **Mark Schildhauer**. 2008. Transforming scientists through technical education: a view from the trenches. *Computing in Science and Engineering: 10*: 28-33.

Madin, Joshua S., Shawn Bowers, **Mark Schildhauer**, Serguei Krivov, Deana Pennington, Ferdinando Villa. 2007. An ontology for describing and synthesizing ecological observation data. *Ecol Info 2*: 279-296.

Michener, William K., James H. Beach, Matthew B. Jones, Bertram Ludaescher, Deana D. Pennington, Ricardo S. Pereira, Arcot Rajasekar, and **Mark Schildhauer**. 2007.

A knowledge environment for the biodiversity and ecological sciences. *Journal of Intelligent Information Systems*, vol. 29, no. 1, pp. 111-126.

Fegraus, Eric H., S. Andelman, M. B. Jones, and **M. Schildhauer**. 2005. Maximizing the value of ecological data with structured metadata: an introduction to ecological metadata language (EML) and principles for metadata creation. *Bull. Ecol. Soc. Amer.* vol. 86, pp.158-168.

Jones, Matthew, C. Berkley, J. Bojilova, **M. Schildhauer**. 2001. Managing Scientific Metadata. *IEEE Internet Computing*, vol. 5, no. 5, pp. 59-68.

SYNERGISTIC ACTIVITIES

Keynote speaker. 2013. *Biodiversity data and the Semantic Web.* At*:* EU BON Kickoff Event, Berlin, Germany.

Science Advisor. 2013 *Encyclopedia of Life* project.

Keynote speaker. 2011. *Opportunities for earth science data interoperability through coordinated semantic development.* At: 1st CUAHSI Conference on Hydrological Data and Information Systems, Logan UT.

Informatics Instructor. 2009. *Distributed informatics solutions for the South African Ecological Observatories Network*. SAEON & Kruger National Park, Republic South Africa.

Keynote speaker. 2009. *Data Integration and Management Solutions for the Environmental Sciences.* At: Data Integration and Management on the Gulf of Mexico, an NSF-sponsored workshop, Corpus Christi, TX.

UCSB lecturer. 2008. Taught quarter-long credit class on *New trends in informatic*s to multidisciplinary graduate student recipients of "Luce Fellowships"

Professional Societies: AGU, Ecological Society of America, IEEE Computer Society, TDWG

Collaborators in last 48 months

(total 36)

Adams, Benjamin Univ of Auckland
Altintas, Ilkay SDSC
Beach, James Univ. of Kansas
Bermudez, Luis Open Geospatial Consortium.
Borer, Elizabeth Oregon State Univ
Bowers, Shawn Univ. of Calif San Diego
Cao, Huiping New Mexico State Univ
Cornillon, Peter Univ Rhode Island
Crawl, Daniel SDSC
Dibner, Phillip OGC Interoperability Institute
Enquist, Brian U. Arizona
Estrin,Deborah UCLA
Fox, Peter Rensselaer Polytechnic Institute
Gallagher, James OPeNDAP
Gamon, John Univ of Alberta
Gates, Ruth Univ Hawaii Manoa
Graham, Eric UCLA
Gries, Corinna Univ. Wisconsin, Madison
Jones, Christopher Univ. of Calif Santa Barbara
Jones ,Matthew B. Univ. of Calif Santa Barbara
Kelling, Steve Cornell Univ.
Kennedy, Jessie Napier Univ.
Kruse, Trisha California Digital Library
Ludaescher, Bertram Univ. of Calif Davis
Madin, Joshua Macquarie Univ
McGuinness, Deborah Rensselaer Polytechnic Institute
Maunder, Mark IATTC
Meyer Carol Foundation for Earth Science
Michener, William Univ. of New Mexico
O'Brien,Margaret Univ Calif Santa Barbara
Peet, Robert Univ. of North Carolina
Pennington, Deana Univ. of New Mexico
Reichman, O. James U. of Cal Santa Barbara
Seabloom, Eric Oregon State Univ
Sibert, John Univ Hawaii
Vieglais, Dave Univ. of Kansas

GRADUATE ADVISOR
Warner, R.R. U. of Calif Santa Barbara

Budget Justification

Personnel. Frank Davis (UCSB PI) will serve as LNCO Executive Director. He is requesting 1.8 months salary support for the first year, 1.5 months for years 2 and 3, and 1 month in year 4.

We request funds to recruit a full-time Communications and Outreach Coordinator at the same rank (Academic Coordinator II, Step 5) as NCEAS Program Director LeeAnne French.

For each year, we are requesting 5 months of salary for co-PI Carol Blanchette, LNCO Education and Training Coordinator, 2.4 months of salary for Co-PI Jennifer Caselle, LNCO Research Coordinator, and 2.4 months of salary for Co-PI Stacy Rebich Hespanha, who will oversee LNCO formative evaluation efforts. We are requesting 1.4 months support annually for Co-PI Mark Schildhauer to direct LNCO computing, 2 months annually for Nick Brand for computing systems administration, and three months annually for a scientific programmer analyst to support synthesis working groups and distributed graduate seminars. Matthew Jones is budgeted for 0.8 months each year for LNCO informatics supervision and training. Funds are also requested annually for three research interns in environmental communications and media, each as a 20% appointment.

Benefits are calculated at actual rates for named individuals and at campus-approved average rates for staff to be named.

Participant Support. Our budget includes participant costs (travel and per diem) for annual Science Council meetings (60 individuals, 5 days and 4 nights), 6 synthesis working group meetings (includes 1-2 DGS synthesis meetings) per year (12 individuals per group, 5 days and 4 nights per meeting) at NCEAS, three meetings annually of LTER committees (e.g., LTER Data Committee, LTER Education Committee), and semi-annual meetings of the LTER Advisory Board (10 individuals, 3 nights, 4 days). We have budgeted travel and per diem expenses for 6 plenary speakers at the All Scientists Meeting, which we assume will take place in Year 3 of the grant period. We understand that for some meetings, actual airfare, lodging and per diem may vary from the rates used here depending on the venue, whether individuals share rooms, etc. The actual number of participants and meeting duration are also somewhat speculative and slightly lower than current meeting size and frequency.

Supplies: We are requesting $14,000 computing supplies annually to help defray costs of software and hardware maintenance to support communications and outreach, synthesis research, and training activities. We are also requesting $2500 annually for communication-related supplies, such as materials needed for press packets and brochures for public outreach.

Other Direct Costs.

The National Center for Ecological Analysis and Synthesis (NCEAS) conducts multiple projects over various funding sources that involve bringing in researchers and scientists from multiple entities and institutions around the world. Since the inception of NCEAS, it has been housed off campus in downtown Santa Barbara. Currently the rent paid for the space is negotiated at $2.52/assignable square foot through June 2017. With NCEAS located off campus, overhead rates are paid at reduced rates thus allowing for direct charges of assignable office space being used by those who work directly on the project. The cost for rental of the NCEAS space is excluded from indirect costs.

Consulting costs for communications specialist Jai Ranganathan are based on an hourly rate of $75 per hour.

We are requesting $5400 (22% of NCEAS telecommunication costs) in year 1 to cover phone and high-speed Internet service from campus. We anticipate theses costs dropping dramatically in Years 2-4 as the center moves to a different Internet solution, and have adjusted our budget request accordingly.

Indirect Costs: Indirect costs are assessed at 26% of Modified Total Direct Costs. This is the DHHS negotiated, predetermined, off-campus rate for Sponsored Research Projects covering the period July 1, 2010 through June 30, 2015. Modified Total Direct Costs exclude participant support costs and rent expenses.

Facilities, Equipment, and Other Resources

Computational resources and network

High performance computing is available on a 48-node, 32-node, and several 16-node clusters, for demanding modeling, statistical, visualization, and data management projects. Access to a 1024-node system on the UCSB campus is also available. Systems are all running 64-bit OSes loaded with state-of-the-art scientific software, and access to storage arrays with aggregate holding capacity in the low-hundreds of terabytes. Connectivity with Internet2 is available through a dedicated 100Mbps link. NCEAS has a number of desktop systems and laptops installed with custom scientific software and internet connectivity available for researchers to use during their visit. Meeting preparation and archival support are available through several web-based collaboration solutions, including code-versioning repositories (subversion; git), issue-tracking software (redmine and bugzilla), Wikis (various) and content-management systems (Plone, Drupal).

Conferencing space and breakout offices

NCEAS houses a state-of-the-art scientific research and conferencing facility, that includes ample meeting space for one-two meetings of 25 persons and an array of collaboration devices, including numerous high-resolution data projectors, smart-boards, and large LED panels. Participants have access to advanced scientific programming expertise in the use of NCEAS' systems, as well as dedicated desktop support personnel. NCEAS provides the facilities, equipment, and staff support to promote the analysis and synthesis of ecological and environmental information. NCEAS is located in the heart of downtown Santa Barbara, with a congenial climate year-round and highly convenient access to a number of amenities relative to dining and off-hours outdoor recreation and cultural entertainment.

LTER National Communication Office (LNCO) Data Management Plan

Roles and Responsibilities

Primary responsibility for all data management decisions and priorities rests with the LNCO Director and co-PIs, who will be assisted by Jones and Schildhauer to design and maintain a state of the art data management system serving LTER communication needs.

Personnel with day-to-day data responsibilities include:

- Brand: systems administration
- Donahue (NCEAS): Personnel and bibliographic databases
- TBN Scientific Programmer: Data system implementation; researcher support/metadata specialist

Co-PI Schildhauer and Jones will be responsible for coordinating LNCO data management activities with the LTER Network Office data management team and site managers.

Types of Data

The LTER Communications Office serves as a nexus for collaborations within LTER and with the broader ecological research community, but will collect relatively little primary field data itself. Data will originate from 3 primary sources: 1) data utilized in and generated by modeling and analysis activities from collaborative synthesis working groups, 2) data generated through assessment and evaluation activities conducted to understand the effectiveness of the LTER and the office, and 3) data collected and maintained on behalf of the LTER network, such as bibliographic databases, personnel databases, etc. Thus, despite the limited collection of field data, the LTER CO will manage a large and heterogeneous set of data products spanning the earth and environmental sciences, including driver data for models and analysis, model output data, environmental observations data and experimental data spanning diverse ecosystems and regions, and social, legal, and policy data used in synthesis studies. In addition, the LTER CO will create, collect, and manage other products of the research lifecycle, including scientific software used in synthesis and analysis, visualization products, and manuscripts and articles arising from LTER research. The project involves a software development component in which the primary outputs requiring long-term maintenance include source code, documentation, schemas, and other artifacts of the development process.

Policies for Access and Sharing and Appropriate Protection and Privacy

LNCO data management will be consistent with current LTER policy as appropriate (http://www.lternet.edu/policies/data-access). Because LNCO data products will be derived from primary data, as opposed to primary data, not all aspects of LTER policy necessarily apply. The primary goal for all policies is to make products of LTER open and accessible for scientists to build upon. The LNCO is committed to long-term preservation, utility, and rapid access to data and products, and thus will minimally require compliance with the LTER-wide data sharing and access policies (http://www.lternet.edu/policies/data-access). All research products, including original data, derived data, source code, documentation, and metadata will be available under an open license, in most cases immediately upon completion of the product, except in cases where this is restricted for legal (e.g., contractual restrictions) or ethical (e.g., human subjects data) reasons (see Type II data in the LTER data policy). Requests for legal or ethical restrictions on data sharing must be requested in advance and in writing and are subject to the approval of the Director, who will ensure compliance with all federal, university, and Institutional Review Board policies on the use of restricted data. For all other data, the

preference will be for release under a CC0 license to clarify that data are not subject to copyright within the US. For software, the preference will be for the Apache 2.0 license where possible due to its permissive nature and its full grant of patent rights. Other open licenses will be allowed as well as appropriate, including CC-BY, MIT, BSD, CC0, etc. The LNCO office will publish a complete set of policies for sharing products of research from LNCO funding. These will first be vetted with the LTER Executive Committee.

Data Storage, Preservation, and Discovery

All public data generated on the project will be fully documented and deposited in multiple repositories, and assigned a DOI, with the goal of for providing long-term preservation, access, and citation. Target repositories will initially include the KNB Data Repository and the LTER Data repository, both of which are members of the DataONE federation. A third replica repository will be chosen that is operated by a financially independent organization to guard against funding loss in the main repositories. Data generated outside of LTER will be also archived unless they are already replicated in long-term, open repositories. DataONE allows access to the public via persistent URLs, provides tools for long-term data management, and enables interoperability among repositories. DataONE has built-in contingencies for disaster recovery, including institutional redundancy of archives, continuous auditing and fixity checking, and recovery plans. Source code, documentation, and other artifacts of the project will be managed on a day-to-day basis in a version control system operated by NCEAS at the University of California. The version control system provides open read access via HTTP and Git protocols, and has contingencies for disaster recovery including redundancy by real-time mirroring offsite and nightly backup. Copies of all open software repositories will be available through community endorsed repositories such as GitHub, although we acknowledge that these are likely to shift over time with technology changes. Permanent, versioned snapshots of code, workflows, and software artifacts will be also deposited in the KNB for each release of the software, or for each version of the products used in a particular scientific paper or product. The LTER CO will also encourage and support the deposition of full provenance information linking all components of synthesis activities, using standards such as the W3C PROV model.

Data, Metadata, and Software standards

Archival products will follow best practices and standards from the community (http://www.dataone.org/best-practices), with a focus on open, non-proprietary formats when these are available. For data, we expect files to be archived in common Unicode text formats such as CSV files, or in open binary formats such as GeoTIFF, netCDF, and HDF5. Metadata will include a full description of data coverage (spatial, temporal, taxonomic), structure, contents, methodology, parameter names and units, and other information needed for proper interpretation. We will use the Ecological Metadata Language (EML) format for most datasets because it is commonly used in the LTER and the KNB Data Repository, but we will also accept and utilize other common community standards as needed, including the FGDC Biological Data Profile and the ISO Geospatial metadata standards (e.g., ISO 19139). Data and metadata management will be supported through tools that directly integrate into scientists' daily workflow, including the ability to submit from the web, form analytical tools such as R and Matlab, from dedicated tools such as Morpho, and from scripting environments like Python.

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT
STEVE GAINES, DEAN, ROOM 2410 BREN HALL

SANTA BARBARA, CA 93106-5131
http://www.bren.ucsb.edu/

May 5, 2015

Frank Davis, Director
National Center for Ecological Analysis and Synthesis
735 State Street, Suite 300
Santa Barbara, CA 93101-5504

Dear Dr. Davis,

The Bren School of Environmental Science & Management at the University of California, Santa Barbara is delighted to partner with the National Center for Ecological Analysis and Synthesis (NCEAS) in support of the new Long-Term Ecological Research (LTER) National Communication Office. We will help you identify outstanding graduate students who are interested in the Bren School's Strategic Environmental Communication and Media focus. These students would be employed part-time as LTER National Communications Office interns, offering great opportunities for real world training in science communication and outreach. For the past several years, NCEAS has routinely employed Bren master's students as communication interns to work with Associate Director of Communications & Outreach LeeAnne French, and this arrangement has been extremely successful. It would be fantastic to expand this partnership to include the new LTER National Communication Office. We look forward to working with you on this exciting project.

Sincerely,

Steven D. Gaines
Dean

PHONE: (805) 893-4339 •gaines@bren.ucsb.edu• FAX: (805) 893-7612