



ANNUAL REPORT

Year 1: 2014-2015



ASU CENTER FOR
BIODIVERSITY OUTCOMES

ARIZONA STATE UNIVERSITY

biodiversity.asu.edu

Annual Report

Year 1
2014-2015



Biodiversity plays a critical role in sustaining humanity through food security, medicine, clean water and air, shelter and a clean healthy living environment. Directed by Leah Gerber, this center strives to accelerate the success of sustainable biodiversity outcomes by cultivating interdisciplinary collaboration and co-producing solutions with governmental and non-governmental agencies, foundations and corporations.

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Table of Contents

EXECUTIVE SUMMARY.....5-6

OVERVIEW.....7

STRUCTURE AND OPERATIONS.....7-8

RESEARCH.....8-20

BIODIVERSITY ASSESSMENT AND DECISION TOOLS.....8-10

- BIODIVERSITY ASSESSMENT
- STRUCTURED DECISION-MAKING AND THE ENDANGERED SPECIES ACT

ADVANCING CORPORATE SUSTAINABILITY.....11-12

- DEVELOPING A DATA DRIVEN DECISION SUPPORT TOOL FOR CORPORATE DECISION MAKING IN WATER
- BIODIVERSITY ACCOUNTING

GOVERNANCE AND BIODIVERSITY.....12-15

- COLLABORATIVE GOVERNANCE FOR IMPROVING BIODIVERSITY OUTCOMES
- RENEWABLE ENERGY AND BIODIVERSITY PLANNING
- DECISION-SUPPORT AND COASTAL PROTECTION SYSTEM TO COPE WITH *SARGASSUM* INVASIONS IN THE MEXICAN CARIBBEAN
- ACTIONABLE SCIENCE, BOUNDARY ORGANIZING AND CO-PRODUCTION OF BIODIVERSITY OUTCOMES

PUBLIC HEALTH AND BIODIVERSITY.....15-17

- INFECTIOUS DISEASES, SYNTHETIC BIOLOGY, AND THE TWO FACES OF EXTINCTION
- IMPACT OF MICROPLASTICS ON HUMAN HEALTH AND THE ENVIRONMENT
- ENVIRONMENTAL AND HUMAN HEALTH EFFECTS OF CONTAMINANTS IN WASTEWATER DOMINATED STREAMS

EDUCATION.....17-20

- BROADENING DIVERSITY IN BIODIVERSITY SCIENCE
- ENGAGING NATIVE HAWAIIAN UNDERSERVED YOUTH IN RESEARCH AND OUTREACH EDUCATION
- TRANSNATIONAL LONG-TERM ANALYSIS OF LOCAL EFFECTS OF CLIMATE CHANGE
- ADDITIONAL EDUCATION ACTIVITIES: IUCN PROGRAMS, UNDERGRADUATE PROGRAMS, GRADUATE PROGRAMS AND FELLOWSHIPS

ADDITIONAL ACTIVITIES..... 20

FACULTY DEVELOPMENT, EXPLORATORY MEETINGS, HOSTED EVENTS

YEAR TWO OBJECTIVES.....22-23

RESEARCH, EDUCATION, FACULTY ENGAGEMENT AND OUTREACH

TABLES, FIGURES, AND ADDENDA.....24-36

Acronym key

AZGF: Arizona Game and Fish
BG: The Biodiversity Consultancy Ltd.
BLM: U.S. Bureau of Land Management
CAP-LTER: Central Arizona-Phoenix Long Term Ecological Research
CBO: Center for Biodiversity Outcomes
CDC: The U.S. Center for Disease Control
CES: Center for Environmental Security
CINVESTAV: The Center for Research and Advanced Studies of the National Polytechnic Institute of Mexico
CLAS: ASU College of Liberal Arts and Sciences
COBI: Comunidad y Biodiversidad
DBG: Desert Botanical Garden
EDF: Environmental Defense Fund
EG: The Earth Genome
EPA: U.S. Environmental Protection Agency
ERB: University of Michigan Erb Institute
FSE: ASU Ira A. Fulton Schools of Engineering
FWS: U.S. Fish and Wildlife Service
GIOS: ASU Julie Ann Wrigley Global Institute of Sustainability
IBAT: IUCN Biodiversity Decision Tool for corporate investors
IPCC: Intergovernmental Panel on Climate Change
IUCN: International Union for Conservation of Nature
LEAF: The Nature Conservancy Leaders in Environmental Action for the Future
LHS: Lahaina High School, Hawaii
NCEAS: National Center for Ecological Analysis and Synthesis
NOAA: National Oceanic and Atmospheric Administration
NMFS: National Marine Fisheries Service
NSF-PIRE: National Science Foundation Partnerships in International Research and Education
MMPATF: Marine Mammal Protected Area Task Force
MSC: McDowell Sonoran Conservancy
MSFI: McDowell Sonoran Field Institute
OIE: World Organization for Animal Health
PEW: Pew Charitable Trusts
PHX Zoo: Phoenix Zoo Arizona Center for Nature Conservation
PN: Pronatura Noroest
RL: IUCN Red List of Threatened Species™
SESYNC: National Socio-Environmental Synthesis Center
SFIS: ASU School of Future Innovation in Society
SMNS: ASU School of Mathematical and Natural Sciences
SNAP: National Center for Ecological Analysis and Synthesis, Science and Nature for People
SOLS: ASU School of Life Sciences
SOS: ASU School of Sustainability
SPREP: Secretariat of the Pacific Regional Environmental Programme
SSC: IUCN Species Survival Commission
TNC: The Nature Conservancy

USABCS: Universidad Autónoma de Baja California Sur
USAID: U.S. Agency for International Development
USGS: The United States Geological Survey
USF: University of South Florida
WSSI: ASU Walton Sustainability Solutions Initiative
WBCSD: World Business Council on Sustainable Development
WCS: Wildlife Conservation Society
WHO: the World Health Organization
WT: Whale Trust

Executive Summary

Biodiversity plays a critical role in sustaining humanity through food security, medicine, clean water and air, shelter and a clean and healthy living environment. ASU’s Center for Biodiversity Outcomes (CBO) strives to accelerate the success of sustainable biodiversity outcomes by cultivating interdisciplinary collaboration and co-producing solutions with government agencies, non-governmental agencies, foundations and corporations. As a boundary organization, CBO has a structure that facilitates collaboration between faculty members and partners. To achieve biodiversity outcomes, we rely on an “actionable science” model designed to cultivate knowledge building between scientists, practitioners and other stakeholders in biodiversity problems. With over 70 Faculty affiliates with expertise ranging from supply chain management to biodiversity informatics we are poised to address research questions relevant to our partners.

Research: CBO supports research partnerships that harness our joint capacity to develop innovative solutions to biodiversity challenges. Both consumers and producers of knowledge collaborate to identify and pursue research questions that will lead to use inspired research and action. Our initial research focal areas include: 1) Biodiversity assessment and decision tools; 2) Advancing corporate sustainability; 3) Governance and biodiversity; 4) Public health and

biodiversity.

Within these focal areas, faculty from across campuses are leading partner-inspired research projects (see report). Thus far, we have received \$358,500 in external support for this work. One highlight is our partnership with the International Union for the Conservation of Nature (IUCN) to advance biodiversity conservation through multiple kinds of biodiversity assessment. The IUCN Species Survival Commission (SSC), a global science-based network of researchers that address conservation issues unique to particular species or species groups, and its associated IUCN Red List of Threatened Species™ (RL) is the global authority on the conservation status of plant and animal species. A formal CBO-IUCN RL partnership, a relationship shared by only two other universities worldwide, will provide ASU primary access to the IUCN data repository, unique opportunities for student engagement in conservation training

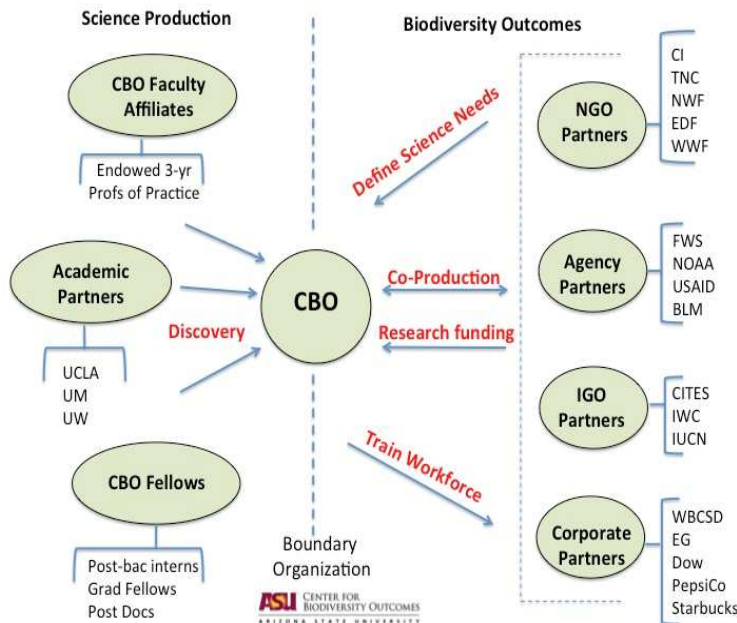


Figure 1. CBO Actionable Science Model. Faculty and graduate students work in collaboration with other academic institutions to frame problems into workable scientific research questions, to build teams of researchers, and to apply existing scientific knowledge to the problems identified by practitioners. The research team then works closely with practitioners in CBO partner organizations to identify additional local stakeholders, and to expand the collaborative teams which co-produce knowledge to address biodiversity problems. CBO works with partners to train graduate students and provide additional training as needed or recommended by partners.

and research, and eligibility for grants. We will showcase our IUCN activities at the [2016 Hawaii World Conservation Congress](#).

Education: Because social inequality in our exposure to and valuation of nature has broad implications for the future of our earth, CBO is developing novel education programs that provide basic literacy in the environment and in ecological sustainability with a particular focus on engagement of underserved youth. To close the gap in social inequality in our understanding of and connection to the natural world, education is integrated into our research objectives via experiential learning. We have approached this challenge at multiple levels: undergraduate, graduate and postdoctoral training. At the undergraduate level, we established a solution-oriented internship program for undergraduate students with partner organizations. Thus far, we have supported five undergraduate students with summer research opportunities.

At the graduate level, we successfully established a graduate certificate in Environmental Communication and Leadership, which will provide leadership training and important skills for early career scientists to communicate science to policy makers and practitioners necessary to achieve biodiversity outcomes. We also established four new graduate fellowships. At the postdoctoral level, we have partnered with The Nature Conservancy (TNC) to support our first *Nature Net-CBO Postdoctoral Fellow*, to offer a unique research and training program that advances the fellow's ability to cultivate innovative scholarship relevant to 21st Century biodiversity challenges.

Additional Activities: In year one CBO invested significantly in cultivating dialogue among diverse disciplines to apply expertise to relevant biodiversity problems. In addition to providing seed funding and in-kind support for formal CBO projects, CBO dedicated considerable resources to developing future partnerships and to networking faculty members and practitioners on different CBO Projects. This was accomplished via workshops, meetings, disseminating research and engaging interdisciplinary faculty and non-academics at public events and small interdisciplinary researcher networking events. Interdisciplinary networking has resulted in surprising collaborations and funding opportunities. We also hosted distinguished speakers, including Dr. Georgina Mace, Dr. Joe Arvai, Dr. Jorge Torre and Dr. Harry Greene. These events were well attended by a diverse group of academic and public audiences.

Year 2 goals: CBO achieved the year one goals articulated in our strategic plan. In year two we plan to increase the number of proposals we submit for external funding to support research initiatives and CBO operations. Research objectives for year two include formalizing our partnership with IUCN and completion of our first water-use decision tool, supported by CBO partner The Earth Genome. We also plan to explore new models to incentivize faculty engagement. For example, our Nature Net-CBO Postdoctoral program is designed to encourage the Fellow to innovate and apply interdisciplinary scholarship in biodiversity science. To achieve this, the Fellow would be expected to collaborate with faculty from CBO-affiliated units. Our education goals for the upcoming year include generating enrollment in the new certificate program, establishing a cluster hire, establishing the first online course in Conservation Science, and developing a Professional Master's program. Finally, we plan to bring at least two diversity students from TNC's Leaders in Environmental Action for the Future (LEAF) program into the undergraduate Conservation Science program at ASU and expand partnerships with organizations that target different stages along the career path.

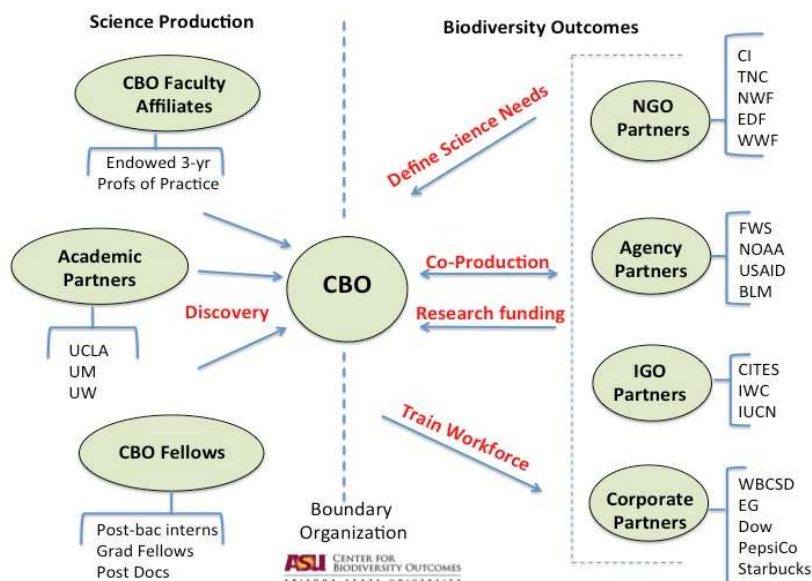
Overview

Meeting today's biodiversity challenges requires innovative research, education, communication and policy strategies capable of responding to a rapidly changing biophysical, institutional and cultural landscape. The Center for Biodiversity Outcomes (CBO) strives to accelerate the success of biodiversity management and sustainable biodiversity outcomes by fostering relationships amongst academics and decision makers. As a boundary organization, CBO has a structure to facilitate collaboration between faculty members and partners (government agencies, non-governmental agencies, foundations and corporations) to develop new programs and launch collaborative research initiatives. The center builds upon a broad platform of expertise across ASU to enable diverse co-production of knowledge in biodiversity science and strengthen the university's research capacity in conservation science and biodiversity.

CBO debuted under the leadership of Founding Director Leah Gerber, Partnership Program Lead Helen Rowe, and Project Manager Anita Hagy Ferguson. Our work was supported by an Executive Committee, an Operations Committee, an Advisory Board, and Faculty Affiliates from numerous units and disciplines across ASU. Additionally CBO was supported by a dedicated staff including an Administrative Assistant (Chelle Brookes) and multiple student workers (see addendums A and B).

Structure and Operations

In our first year we convened three strategic planning meetings with our Advisory Board and additional meetings with our operations and executive committees during which we developed and finalized a strategic plan, a logic model and time table for year one and two activities, and defined metrics for evaluating our success. We developed the CBO budget to correspond to activities outlined in our strategic plan. We worked closely with the Julie Ann Wrigley Global Institute of Sustainability (GIOS) and the School of Life Sciences (SOLS) to develop a MOU that established CBO as the first ASU Center shared by an Institute (GIOS) and a college (College of Liberal Arts and Sciences, CLAS) incorporating the School of Sustainability (SOS) and SOLS units.



ASU faculty and graduate students work in collaboration with other academic institutions to frame problems into workable scientific research questions, to build teams of researchers, and to apply existing scientific knowledge to the problems. The research team then works closely with CBO partners to identify additional local stakeholders, and to expand the collaborative teams which co-produce knowledge to address

the biodiversity problem. CBO works with partners to train graduate students and provide additional training as needed or recommended by partners. One of CBO's goals is to bring non-academic knowledge into the research institution by providing an avenue for a partner representative to teach and conduct research as a "Professor of Practice". This Actionable Science model is designed to encourage interdisciplinary collaboration and increase dialogue and knowledge building between scientists, practitioners and other stakeholders in biodiversity problems.

Research

CBO supports research partnerships that harness joint capacity to develop innovative solutions to biodiversity challenges. Both consumers and producers of knowledge collaborate to identify and pursue research questions that will lead to use inspired research and action. Through a series of advisory board meetings, partner consultations, and faculty affiliate input, CBO identified and supported projects in four research focal areas during its first year (see addendums C and D):

1. Biodiversity assessment and decision tools
2. Advancing corporate sustainability
3. Governance and biodiversity
4. Public health and biodiversity

Activity:

Focal Area 1: Biodiversity assessment and decision tools

CBO researchers work with national and international partners to develop and apply innovative ways to assess biodiversity and decision tools in order to conserve and manage biodiversity.

Project: Biodiversity Assessment

Project leads: Beth Polidoro, School of Mathematical and Natural Sciences (SMNS); Andrew Smith, SOLS

Partners: [IUCN SSC](#); [Desert Botanical Garden](#) (DBG); [Phoenix Zoo Arizona Center for Nature Conservation](#) (PhxZoo); Marine Mammal Protected Area Task Force (MMPATF); [National Marine Fisheries Service](#) (NMFS); TNC; [Science for Nature and People](#) (SNAP); [Wildlife Conservation Society](#) (WCS)

Funding: CBO has been awarded \$125,000 by the NCEAS *Science and Nature for People* program and a CBO seed grant (\$7500).

Description: The IUCN SSC relies on a broad network of volunteer researchers and institutions to collect and maintain species data used to inform governments, researchers and organizations in making conservation decisions. The IUCN has many members, including ASU's GIOS, but partnership status is restricted to twelve or fewer organizations that make exceptional contributions to the IUCN. Currently, the only two other universities holding partnership status with the IUCN are Texas A&M and Sapienza University, Rome.

Many CBO faculty affiliates have established relationships with the IUCN, have contributed for many years to IUCN data sets, and have advanced IUCN conservation initiatives including the IUCN SSC and the IUCN World Commission on Protected Areas (WCPA), a global network that helps governments and key stakeholders establish and integrate protected areas into other sectors. Additionally, CBO partners the PhxZoo and the DBG both have established connections to IUCN. Responding to the breadth of ASU-IUCN connections, CBO hosted and funded the

visit of an IUCN delegation in February 2015 to explore development of a formal CBO-IUCN RL partnership and additional opportunities for collaboration.

CBO engages faculty affiliates, graduate students and contractors to advance the mutual goals of CBO and the IUCN. We have formed a CBO-IUCN subcommittee and provided one summer month salary to faculty affiliate, Beth Polidoro (Co-Chair IUCN SSC Marine Fishes Specialist Group) to coordinate and lead CBO's IUCN-related activities and communications. Additionally we have retained Penny Langhammer (Co-Chair, WCPA/ SSC [Biodiversity & Protected Areas Joint Task Force](#) and ASU adjunct faculty member) for a two-year IUCN consultancy.

Activity:

Red List Partnership: CBO will submit a proposal (Fall 2015) for the CBO-IUCN Red List partnership, which will summarize a plan and vision for CBO's "niche" in terms of species expertise and "outcomes" and provide an appraisal of the value of ASU contributions that meet the IUCN partnership dollar or in-kind contribution requirement of \$200,000 (which can be fulfilled through working on completing species RL assessments and other services). CBO's partnership with IUCN will provide ASU primary access to the IUCN data repository, unique opportunities for student engagement in conservation training and research, and eligibility for grants. CBO will be considered in the IUCN re-negotiation process of the RL partnership in Spring 2016.

Key Biodiversity Area (KBA) Standard: The IUCN has established a new standard for determining KBAs, which are places that have international biodiversity conservation significance. CBO has developed a proposal in collaboration with WCS and other partners to support implementation of the new standard for KBAs, development of the documentation standards, methods, and tools to record, predict, and economically value ecosystem services and human well-being benefits delivered by KBAs, and through output of peer reviewed publications. CBO faculty affiliates will collaborate with IUCN on an analysis of transboundary KBAs, which are KBAs with complex governance structures, such as a KBA spanning two countries. CBO's report will be presented at 2015 KBA and SSC meetings. CBO is also working with the IUCN Joint SSC/WCPA MMPATF, and the NMFS to align the Important Marine Mammal Area initiative with the KBA Standard and support pilot KBA identification for marine mammals.

Sonoran Desert Ecoregion Assessment and Gulf of California KBA: CBO and local partners are developing a collaborative project for KBA identification in the Sonoran Desert and Gulf of California under the new IUCN Standard. CBO has funded development of a taxonomically comprehensive plant species list for the Sonoran Desert Ecoregion. The list is being compiled by two ASU graduate students under leadership of ASU faculty members. This effort will lead to a new Species Survival Plan (SSP) for desert plants for which the DBG will collaborate in the reassessment of cacti species. We will submit a Sonoran Ecoregional Assessment Proposal to the ASU Foundation.

Species Red List Assessments: CBO is collaborating on additional IUCN species assessments: 1) We are helping to complete the IUCN RL assessments for marine fishes, which entails completing evaluations for 1000 fish species from the Eastern Central Atlantic for publication on the IUCN RL in November 2015; 2) We are developing a work plan, which includes a possible workshop at the biennial marine mammal conference to complete RL assessments for small cetaceans and large whales. These assessments contribute to CBO's in kind contribution to the IUCN RL Partnership. CBO is also exploring a partnership with the

PhxZoo to formalize its partnership with the SSC Small Carnivore and Lagomorph Specialist Groups. This partnership would enable CBO and the zoo to train and support students working on species RL assessments across these taxonomic groups.

Green List of Protected Areas: CBO is considering ways to contribute to IUCN's [Green List](#), a new initiative that assesses the success of protected areas and aims to share information so that successes can be modeled by others, thereby providing greater benefits to humans and nature.

Measuring Biodiversity Returns: CBO is collaborating with IUCN and others to explore how KBAs can be used to measure biodiversity return on investment for corporate investors, and potentially expand on the current IUCN Biodiversity Decision Tool for corporate investors (IBAT).

Red List and KBA Training Program at ASU: Red listing and assessment of KBAs requires specialized training. CBO is conducting a feasibility study (including a proposal and budget) on creation of an RL and KBA training program at ASU. The ASU training center will maximize outputs by training individuals that can work as trainers in RL assessments and KBA identification to governments and others by request. There is substantial demand for these types of trainings.

IUCN World Conservation Congress (WCC): CBO will participate substantively in the 2016 Hawaii WCC. This significant congress will be held for the first time in the U.S., in Honolulu, Hawaii in September 2016. In collaboration with the GIOS-IUCN liaison, we will prepare a proposal for submission to host a session and/or events for the WCC that encompass participation in the planned conservation campus, public engagement events, and the main programme and Members' Assembly.

Related Publications:

- Gerber L. 2015. A deal with Japan on whaling? *Frontiers in Ecology and the Environment* 13: 347–347. <http://dx.doi.org/10.1890/1540-9295-13.7.347>

Project: Structured decision-making and the Endangered Species Act (ESA)

Project Lead: Leah Gerber, SOLS

Partners: [United States Fish and Wildlife Service](#) (FWS); [University of Michigan Erb Institute](#) (ERB); [National Socio-Environmental Synthesis Center](#) (SESYNC).

Funding: CBO is being supported by SESYNC (\$85K).

Description: Protection of species under the ESA is a challenging and often controversial task that requires input from a variety of environmental, economic, social, and political interests. The FWS, responsible for recovery of most listed species, is faced with an increasing workload and decreasing resources. Additionally, the FWS lacks a means to prioritize conservation actions that can be applied consistently across species. In light of an increasing list of imperiled species requiring evaluation and protection, the FWS is exploring new ways to address this overwhelming management challenge. Project leads are collaborating with FWS agency scientists to develop a general decision framework to facilitate recovery and spending decisions.

Activity: CBO is collaborating with FWS staff to facilitate a structured decision-making process. The first meeting at SESYNC will take place in October 2015.

Related Publications:

- Troyer, C.M and L.R. Gerber. Forthcoming 2015. Assessing the impact of the U.S. Endangered Species Act recovery planning guidelines on managing threats for endangered species. *Conservation Biology*. June 24. doi: [10.1111/cobi.12552](https://doi.org/10.1111/cobi.12552).

Focal Area 2: Advancing Corporate Sustainability

Government agencies, non-profits and corporations require both data and analytical tools to make informed decisions about operations. Corporations develop sustainable practices and marketing not only because of the favorable imaging, but because sustainable practices can also improve profitability of a company. However, corporations and other institutions do not always have enough information to make the best choices to maximize sustainable impacts. We are synthesizing data and developing new analytics to help weigh trade-offs more accurately and improve biodiversity outcomes.

Project: Developing a data driven decision support tool for corporate decision making in water

Project Leads: John Sabo, SOLS and Ben Rudell, Fulton School of Engineering (FSE)

Partner: [The Earth Genome](#) (EG), [Environmental Defense Fund](#) (EDF), [World Business Council for Sustainable Development](#) (WBCSD)-Water Cluster, Dow Chemical, Pepsico and CH2M Hill.

Funding: The EG has supported this work with a gift of \$100,000.

Description: The EG is a non-profit organization that aims to create inexpensive, easy-to use tools that enable corporations to make sustainable decisions that protect biodiversity. CBO is working with the EG to provide the necessary scientific expertise to develop credible decision-support tools that corporations need to make informed decisions. It is the shared belief of CBO and the EG that if we work directly with decision-makers to build the information systems they need to incorporate the environment into their decision-making and long term cost calculations, we will see vastly improved outcomes for both the corporations and for natural systems. These results will shift norms and drive mainstream adoption in the public and private sectors.

CBO and the EG work together to garner corporate and foundation support and engagement, host workshops, co-develop and test products, and to communicate outcomes widely through academic and popular media. The EG brings high-level leadership expertise in both conservation and corporate management and integrates the two into corporate sustainability. The EG has established corporate partnerships with member companies of the WBCSD.

The EG and CBO have signed a MOU and have begun work on an initial project to develop a decision support tool to enable corporations to make sustainable decisions about water use. This web based, data-driven support tool will help water-intensive corporations make better decisions about how much and where to invest in green infrastructure in order to deliver better storage, higher quality water and flood control. The tool will allow companies to compare life cycle costs of green (nature-based) and gray (human engineered) infrastructure in providing water services. Our pilot tool is being developed to help Dow Chemical screen potential sites in the Brazos River basin in Texas in which they can restore river-floodplain connectivity and wetlands to enhance upstream storage and offset the need for more expensive gray alternatives, including reservoir construction and desalination. The goal of the project is to scale the tool to provide screening capabilities for the whole U.S. and India such that it is relevant to facilities and projects of a larger number of WBCSD water cluster companies.

Activity: The EG and Project leads conducted client interviews with ten WBCSD water cluster companies and participated in a March 2015 workshop at CH2M Hill headquarters to define and co-produce the tool with WBCSD water cluster companies. The team has refined the approach and initiated data driven models to quantify water benefits of wetland restoration and hired a postdoc to continue and further this work.

Project: Biodiversity Accounting

Project Leads: Leah Gerber, SOLS

Partners: IUCN; EG; WBCSD; TNC; EDF; [The Biodiversity Consultancy Ltd](#) (BC); SNAP

Funding: Project leads have submitted a proposal to Earth Genome and WBCSD partners.

Description: There is a pressing demand for an accounting system for biodiversity in the corporate sector. Many corporations (e.g., Pepsi, Chevron, etc.) make corporate commitments to biodiversity as part of their public relations strategy, yet these companies do not have the data or expertise to rigorously consider biodiversity in daily operations. Part of the problem is that existing biodiversity data vary in quality, quantity, availability and operability. In addition to the need for systematic biodiversity accounting, we lack decision tools to conveniently and effectively consider biodiversity in business decisions. We will bring together data on biodiversity from multiple sources (e.g., global databases, proprietary databases) and develop new methods to integrate these biodiversity data into corporate decision-making. We will then use these data to develop an “investment grade” decision tool that allows corporations to consider biodiversity as a form of “risk management”. Building on this niche and our expertise in biodiversity assessment, corporate supply chains, and tool design, we are poised to build new approaches to help businesses account for biodiversity in their decisions.

Activity: CBO and a team of partners assembled this summer at the National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara to discuss biodiversity and water conservation in business. Partners representing The Earth Genome, The Environmental Defense Fund, The Nature Conservancy, and the UCLA Institute of the Environment and Sustainability joined forces with CBO to initiate development of a decision-support tool that will help corporations assess risks to the public, the environment, and their business associated with their water use. The team plans to bring together a wide variety of biodiversity data to help corporations actively consider biodiversity in their activities.

Focal Area 3: Governance and biodiversity

Management agencies have unique management mandates and processes for reaching decisions. Non-profit conservation organizations often work with public agencies to help stakeholder processes and to enhance collaboration on solutions that can benefit people and biodiversity. Researchers at ASU are interested both in studying the efficacy of different approaches to decision making and stakeholder involvement on biodiversity as well as contributing scientific expertise and aligning research to the stakeholder process.

Project: Collaborative Governance for Improving Biodiversity Outcomes

Project Lead: Mike Schoon, SOS

Partners: TNC; [Programme for Ecosystem Change and Society](#) (PECS)

Funding: This project is supported by a CBO seed grant (\$7500). Current plans are for a grant submission to the National Science Foundation (NSF) Decision, Risk Management (DRMS) grant with a due date in January to facilitate additional fieldwork and support students.

Description: Countries worldwide are faced with the need to simultaneously redress past injustice, support social transformation and promote more equitable access to ecosystem services. Many countries have opted for co-management arrangements between conservation agencies and local communities as a means to achieve these goals simultaneously. Experiences of collaborative governance and management appear to have differed significantly between

developed and developing countries. However, in the thirty or so years since co-management began to be practiced worldwide, there has not been a systematic multi-country assessment of the practical experiences of co-management as a viable option for ensuring more equitable access to ecosystem services as part of broader development and conservation imperatives.

In collaboration with the International Council for Science, we are working with local stakeholders to synthesize data on local collaborative governance across developed and developing country case studies. One example is a local collaboration with TNC and others to study the structure and efficacy of natural resource-based collaborative processes amongst non-profit conservation organizations, stakeholder groups, and national and regional governmental agencies.

Activity: Schoon's team conducted semi-structured interviews with key stakeholders in six collaborative governance arrangements throughout Arizona in the summer of 2015. These collaborations included arrangements for forestry and fire management (Huachuca Firescape Plan, Chiricahua Firescape Plan, White Mountains Stewardship, and the Four Forests Restoration Initiative) and water management (Colorado River Plan and Las Cienegas National Conservation Area). These interviews are being transcribed to allow coding for Qualitative Content Analysis and social network analyses in the next phase of research. Concurrently, we have an agent-based model developed that is running simulations on collaboration and learning. The team is currently completing a review paper on "Collaborative Transformations toward Ecosystem Stewardship" for the Transformations conference in Stockholm in October 2015 and Future Earth's Programme for Ecosystem Change and Society (PECS) Conference in South Africa in November 2015. This review paper will target *Global Environmental Change* or *Ecology and Society*. In addition, we will develop peer-reviewed journal articles based on preliminary field data over the coming months.

Project: Renewable energy and biodiversity planning

Project Lead: Abby York, SHESC and Clark Miller, School of Future Innovation in Society (SFIS)

Partners: TNC; [Bureau of Land Management](#) (BLM)

Funding: A grant proposal is pending for \$170,899 in support of companion study "CNH-S: Resilience of social-ecological systems under the stress of shale oil and gas production in Ohio".

Description: Efforts to decrease our dependence on fossil fuels and reduce our carbon footprint lead to efforts to expand renewable energy sources. Renewable energy sources, while "clean" in some respects, may pose wildlife threats and damage to natural systems. For example, ex-urban solar installations require new transmission lines and land clearing for the solar panels. Wind turbines can cause high bird mortality. The BLM has engaged in regional solar energy planning including a Solar PEIS (programmatic environmental impact statement) and identifying Solar Energy Zones. This year, in cooperation with Argonne National Lab, the BLM is undertaking a regional mitigation planning effort for the three Solar Energy Zones in Arizona.

CBO project leads are working with the BLM and TNC to develop planning tools and recommendations. They propose to develop a comprehensive spatial map of the Sonoran Desert to identify Conservation Areas and conversely areas with low conservation value based on extensive species and ecological data. The map will enable the BLM to perform cumulative assessments and collective impact analysis so that mitigation strategies can be most targeted and effective. Companion studies on mitigation are planned that will identify the most effective

techniques, strategies, and costs. Finally, these approaches will be evaluated from a policy perspective to articulate a new process that may benefit all parties through reduced uncertainty and improved information delivery.

Activity: CBO facilitated scoping meetings with the BLM and TNC to discuss regional solar planning including solar regional mitigation strategies for three solar energy zones (SEZ). Project leads will write a white paper to AZ Smart (solar energy company) on biodiversity planning, tradeoffs, and risks with solar development. This research will be connected to the CBO-sponsored Sonoran Ecoregional Assessment.

Project: Decision-support and coastal protection system to cope with *Sargassum* invasions in the Mexican Caribbean

Project Lead: David Manuel-Navarrete, SOS

Partners: [Universidad Autónoma de Baja California Sur](#) (USABCS); [Comunidad y Biodiversidad](#) (COBI), [The Center for Research and Advanced Studies of the National Polytechnic Institute of Mexico](#) (CINVESTAV).

Funding: Project lead will be seeking funding from the Hotel Association of Cancun and Puerto Morelos, the government of the Quintana Roo state, Mexico, which have funding and budgets to address the *Sargassum* problem.

Description: *Sargassum* is a type of algae found normally in Caribbean oceans. While *Sargassum* provides an environment for distinctive and specialized marine life, recent massive influxes are detrimental for the marine fauna and tourism activities and could in the long-term cause coastal dead zones. The causes of these massive influxes are uncertain, but may be related to increases in land-based nutrients and pollutants from fertilizers and sewage, warmer surface temperatures and changes in ocean circulation associated with climate change, and a high flow of nutrients from the Amazon and Orinoco Rivers mixing with warmer ocean temperatures.

These causes are unlikely to recede in the short term and their mechanisms fall outside the purview of local authorities and tourism actors. However, scenario analysis can support local actors to respond by mitigating negative impacts, taking advantage of new opportunities, or adapting to inevitable consequences. This project uses scenario analysis, agent-based plus optimization modeling, and design thinking to provide a *Sargassum* decision-support and coastal protection system that anticipates trade-offs of potential response pathways. The collaborative research team will work with tourism actors and government officials to design an inter-institutional coastal protection system based on the information generated by the models.

Activity: This project is currently in the proposal development stage and the CBO project team is making inquiries to *Sargassum* work being done at Texas A&M and refining the proposal for possible collaboration.

Project: Actionable Science, boundary organizing and co-production of biodiversity outcomes

Project Lead: Anita Hagy Ferguson, SHESC; GIOS and Clark Miller, SFIS

Partners: SESYNC; SNAP; USGS; [Pew Charitable Trusts](#) (PEW)

Funding: CBO will work with partners to identify funding opportunities for this project as specific project needs are determined.

Description: Boundary organizations aim to connect science to policy or management by mediating the flow of information among scientists, decision-makers, and other stakeholders. These organizations are increasingly common, but they are unlikely to fall within conventional expert roles or academic disciplines and therefore lack peer communities. CBO is researching

how boundary organizations work in conservation to enable actionable science. Through seminars and workshops with an array of boundary organizations, CBO and partners are building a dialogue that addresses various aspects of the theory and practice of boundary organizations with a view to highlighting the opportunities and challenges inherent to working at the boundary of science, policy and practice.

Activity: CBO is currently working with partners to research and advance actionable science. Projected products include a workshop, a symposium, an event at the National Center for Ecological Analysis and Synthesis (NCEAS) and published works.

Focal Area 4: Public Health and Biodiversity

Environmental contaminants affect ecosystem health and lead to threats to human health. CBO researchers are investigating these links and working to deliver effective public outreach messages.

Project: Infectious diseases, synthetic biology, and the two faces of extinction

Project Lead: James Collins, SOLS

Partners (proposed): IUCN; the [World Health Organization](#) (WHO), [The U.S. Center for Disease Control](#) (CDC), [the World Organization for Animal Health](#) (OIE), and [the Intergovernmental Panel on Climate Change](#) (IPCC)

Funding: This project is supported by a CBO seed grant (\$7500). Project lead will aim to submit proposals to OKED in 2016.

Description: The recent global loss of species is being described as a sixth extinction, which means that if current losses of biodiversity go unchecked they will constitute an event equal to one of the five mass extinctions this planet has already experienced. Species extinction happens with or without human intervention. Since our evolution as a species, however, we have had a role in the extinction of other species either deliberately, inadvertently, or more often through a mix of the two. Humans have and are causing species extinctions. In recent years there has been a push to drive some life forms--pathogens in particular (Smallpox for example)—to extinction. Some may question designating viruses as life forms, but the sort of program designed to drive pathogens to extinction is also at work in the case of more complex organisms. There is a need to think through the environmental, ethical, and regulatory implications of developing and releasing this sort of synthetic biology technology. We need research, policy work, and an examination of the rules governing the new methods and release of organisms.

CBO is supporting the development of workshops to explore deliberate extinction, the converse of conservation or preservation of species. The workshops will gather together a group of scholars willing to think deeply and carefully about what we are doing through deliberate extinction and why.

Activity: In fall 2015, project leads will organize workshops to begin addressing the principal question: *What circumstances might justify deliberately driving a species extinct?*

Project: Impact of microplastics on human health and the environment

Project Leads: Rolf Halden, Center for Environmental Security (CES) and Beth Polidoro, SMNS

Partner: [Secretariat of the Pacific Regional Environmental Programme](#) (SPREP), [Environmental Protection Agency \(EPA\) Region 9](#), and [American Samoa EPA](#).

Project Description: Marine and freshwater species can absorb contaminants through ingestion of microplastics in their environments, which can accumulate in the body and partition into body

tissue. Around the world, people consume seafood with the risk of possibly being exposed to these contaminants. CBO is working with project leaders to design risk assessment research to determine which types of plastics have more potential to sorb contaminants and which marine and freshwater species have potential to absorb those contaminants. Further, CBO and project leads are considering how their research can inform policy for better management of solid waste, including the introduction of plastics, leachates and other contaminants into freshwater and marine environments (e.g. marine debris).

Funding: In-kind support from American Samoa EPA for initial study conducted in American Samoa in June 2015.

Activity: CBO conducted numerous meetings with CBO faculty to determine potential avenues for research collaboration amongst ASU faculty and external researchers at the NCEAS, and designers who seek to create products that are sustainable and benign to the environment. Project leads are exploring the environmental and human health impacts of effluent dominated streams, and of contaminants present in recreationally caught fishes in the Phoenix-metro area. Polidoro was a panelist in a session on Ocean Health at the Pacific Islands Environmental Conference in American Samoa in June 2015 as well as worked with EPA Region 9 and the American Samoa EPA to collect preliminary data from streams, beaches and marine environments in the region.

Project: Environmental and human health effects of contaminants in wastewater dominated streams.

Project Leads: Rolf Halden, CES and Matthew Scotch, CES

Partner: EPA and the United States Geological Survey (USGS).

Project Description: Since the majority of consumer chemicals and their transformation products used in human society are flushed down the drain, efficient chemical monitoring in wastewater treatment plant (WWTP) process flows may provide near-real time information on chemical usage and environmental dispersion in communities. Hence, we conduct urban metrology by using WWTPs as observatories of chemical and biological agents entering and leaving cities. In this ongoing project we are developing, validating and applying this urban metrology approaches to WWTP effluents and receiving streams to create a novel, real-time tool for understanding the flux, fate, exposures and toxic effects of chemical and biological agents of concern in the environment, using state-of-the-art analytical techniques and bioassays.

The work is conducted at ASU's CES that houses the Human Health Observatory (*H2O*), a unique resource representing tens of thousands of environmental samples including wastewater, sludge, sediments and groundwater collected from diverse locations across the U.S, as well as specimen samples of human tissues and biofluids useful in quantifying real-world toxic exposures. The present project leverages this previously established sample repository and a network of WWTPs through collaboration with U.S. EPA and USGS, to demonstrate and validate the accuracy and utility of this paradigm-shifting monitoring approach for understanding human activities in urban centers and their impacts on surrounding ecosystems and biodiversity.

Funding: Project leads are planning a proposal to the EPA.

Activity: CBO facilitated several meetings to facilitate work with the EPA and the USGS. Their research was featured in [Environmental Health Perspectives](#) (Vol. 132, No. 2, February 2015) in a news focus on marine plastic pollution and seafood safety.

Related Publications:

- Xue, J., A. K. Venkatesan, Q. Wu, R. U. Halden and K. Kannan.* 2015. Occurrence of Bisphenol A Diglycidyl Ethers (BADGEs) and Novolac Glycidyl Ethers (NOGEs) in

Archived Biosolids from the U.S. EPA's Targeted National Sewage Sludge Survey. *Environ. Sci. Technol.* 2015, 49, 6538-6544, DOI: 10.1021/acs.est.5b01115.

- Venkatesan, A. K., A. M. Hamdan, V. M. Chavez, J. D. Brown, R. U. Halden*. 2015. Mass Balance Model for Sustainable Phosphorus Recovery in a U. S. Wastewater Treatment Plant. *J. Environ. Qual.* (In Press)
- Hartmann, E. M., D. R. Colquhoun, K. J. Schwab, and R. U. Halden.* 2015. Absolute Quantification of Norovirus Capsid Protein in Food, Water, and Soil Using Synthetic Peptides with Electrospray and MALDI Mass Spectrometry. *J. Hazardous Materials* 286: 525-532.
- Halden, R. U.,* E.M. Hartmann, N. D. Denslow, P. A. Haynes and J. LaBaer. 2015. Recent Advances in Proteomics Applied to Elucidate the Role of Environment Impacts on Human Health and Organismal Function. *J. Proteome Research* 14(1):1-4. DOI: 10.1021/pr501224f. <http://pubs.acs.org/doi/abs/10.1021/pr501224f>
- Halden, R. U.* 2015. Epistemology of Contaminants of Emerging Concern and Literature Meta-analysis. *J. Hazardous Materials* 282:2-9. <http://www.sciencedirect.com/science/article/pii/S0304389414007663>

Education

Nature has become a foreign concept to younger generations, especially those from underserved communities. This social inequality in our exposure to and valuation of nature has broad implications for the future of our earth. CBO is developing novel education programs that provide basic literacy in the environment and in ecological sustainability with a particular focus on engagement of underserved youth.

Project: Broadening diversity in biodiversity science

Project Leads: Sharon Hall (SOLS); Anita Hagy Ferguson; Kimberly A. Scott & Gabriel Escontrías, Jr., [Center for Gender Equity in Science and Technology](#) (CGEST)

Partners: TNC, NWF, [Ecological Society of America](#) (ESA), [University of Michigan \(UM\)](#), [University of Washington \(UW\)](#), [Yale School of Forestry and Environmental Studies](#) (YSFES), [National Oceanographic and Atmospheric Administration](#) (NOAA)

Funding: We are exploring potential gifts and grants to support our summer STEM diversity program and we are working with TNC and NWF to identify ways to leverage our joint resources.

Project Description: Conservation science lacks diversity students. Diversity in research contributes to diversity in knowledge building, which is needed to solve complex global conservation problems. CBO is working with internal and external centers, organizations and schools to identify promising underserved high school students, recruit them to ASU, mentor them through university and provide professional opportunities that see graduates into successful and impactful careers in conservation science and policy.

Activity: CBO is collaborating with the CGEST to develop a university wide summer Science, Technology, Engineering and Math (STEM) diversity program, of which conservation science

will be one focus. We are developing partnerships with TNC and the NWF to target underserved youth and get them into ASU. In addition, CBO hosted a workshop (August 2015) at the ESA Centennial Meeting in Baltimore, MD on *what works to recruit, matriculate, and retain disadvantaged youth in undergraduate ecological degree programs?* CBO is hosting Dr. Peter Kareiva from TNC and the UCLA Institute of the Environment and Sustainability October 2015 to engage on the issue of diversity in conservation at ASU.

Project: Engaging Native Hawaiian underserved youth in research and outreach education

Project Leads: Yaiyr Astudillo-Scalia, SOLS and Leah Gerber, SOLS

Partners: NOAA, [Maui Whale Trust](#) and [Lahaina High School](#) (LHS)

Project Description: We are developing a collaborative vision for a research and education program with LHS and Maui Whale Trust. Initial ideas for the program include an intensive two-week program/internship program that includes field research, a chance to visit ASU and lab experience (with a piece of the lab work that is feasible for young students). Should this initiative be successful, partners will consider subsequent projects that might involve the creation of a permanent research station to facilitate marine research for local students as well as students from other institutions outside HI.

Funding: Pilot research was supported by a \$2500 grant from the Maui Whale Trust. Results from our pilot study to explore philanthropic support from a local donor.

Activity: Project leads met with partners NOAA, Maui Whale Trust and LHS in Hawaii to discuss donor support and to establish an initiative that would integrate the research efforts of local NGO (Maui Whale Trust) with STEM education and outreach (LHS and ASU).

Project: Transnational long-term analysis of local effects of climate change

Project Leads: Leah Gerber and Monica Elser

Partners: [University of South Florida](#); [Pronatura Noroeste](#); COBI; [Centro para la Biodiversidad Marina y la Conservación](#); [National Science Foundation](#) (NSF)

Funding: A proposal was submitted to the National Science Foundation, Partnerships in International Research and Education (PIRE). The full proposal was \$5,000,000 and the request for the CBO education component was \$1,500,000. The proposal was one of four that passed the initial round of review, but it was not selected for funding.

Project Description: The effect of climate change on processes in regional, coastal, and shelf seas is a key issue in Mexico today. Climate and global change impacts already being observed across marine ecosystems include distributional shifts due to warming, arrival of invasive species, and changes in local species composition as a result of physiological intolerance to new conditions. This project models the ecological impacts of climate and global change in three Large Marine Ecosystems (one in Mexico and 2 shared by U.S.-Mexico): we blend state-of-the-art highly-mechanistic and less-complex modeling approaches to link global projections of climate change effects to species, populations, ecosystem function and structure, fisheries, fishery-based economies, coastal livelihoods, and management.

This essential international collaboration analyzes responses across transnational marine systems, allowing researchers to share data and research approaches, inform management, cement existing collaborations, and help engage a future generation of researchers. Involving a wide variety of expertise, the project allows researchers to comprehensively analyze climate change effects across the marine ecosystem and associated coastal areas. The complex project

involves a comprehensive education component to be led by CBO. The education programs are designed to help young scientists acquire interdisciplinary skills to respond to diverse challenges in a rapidly changing world.

The educational component implements an integrated program for K-12 teachers, undergraduate and graduate students, early-career professionals, and resource managers. Additionally, climate change science provides multiple opportunities to improve STEM education by integrating complex interdisciplinary themes, mathematical and statistical concepts, and computer modeling. The educational program will be aimed at increasing capacity on how climate and global change research can be applied to understanding coupled marine social-ecological systems through a series of courses and workshops.

Activity: Education project leads met to finalize the education plan, identify resources, capacity, and potential challenges to the research.

Additional Educational Opportunities:

IUCN Opportunities: All CBO-IUCN collaborations offer opportunities for undergraduate and graduate education through incorporation of IUCN materials into ASU classes; establishment of training courses for IUCN material (e.g., the [RL Training Course](#)); development of training courses for IUCN material (e.g., KBA identification); and internship placement into IUCN (for which a possible funding source could be the new [NSF Research Traineeship Program](#)). CBO will link its IUCN-related programs to its youth engagement and diversity in conservation research programs in order to provide opportunities for internships and professional experience to underserved youth.

Undergraduate Programs: CBO is working to strengthen the conservation science undergraduate curriculum and create an online tool for navigating biodiversity programs and courses at ASU. We are working with SOLS undergraduate curriculum staff to include more interdisciplinary opportunities in the conservation biology curriculum, and we are exploring development of online course opportunities for undergraduates. We are interfacing with the Central Arizona Chapter of the Society for Conservation Biology (CACSCB) to support a community of undergraduate conservation scholars, and we are working with TNC, NWF, USFWS, Arizona Game and Fish (AZGF) and other agencies and organizations to provide internship and professional opportunities to undergraduate students. CBO also supported five undergraduate students with summer research opportunities in year one.

Graduate Programs: CBO successfully established a new graduate certificate in Environmental Communication and Leadership. The certificate will provide leadership training and important skills for early career scientists to communicate science to policy makers and practitioners to help achieve biodiversity outcomes. The certificate will prepare graduates to move into positions of leadership, engage with society, and change their academic institutions from within.

Graduate Student Fellowships and Support: CBO supported travel for five graduate students to present conservation research at multiple interdisciplinary conferences. CBO has partnered with several external organizations to offer a several fellowships to graduate students. The McDowell Sonoran Conservancy Biodiversity Fellowship co-funded by SOLS and McDowell Sonoran Conservancy is awarded in the amount of \$12,000 per year to a graduate student. The Huizingh Desert Research Fellowship, co-funded by SOLS and the DBG, provides five years of funding for a PhD student.

Postdoctoral Fellowship Program: CBO has a recently partnered with TNC to join six other Universities (Cornell, Columbia, Princeton, Stanford, University of Pennsylvania and Yale) that

offer the prestigious [NatureNet Science Fellows Program](#). This program will provide support for early career scientists to conduct research at the interface of science, technology and business in order to achieve biodiversity outcomes. With a gift from TNC, we garnered an institutional match to support this program at the University, College and Unit level. Faculty from contributing units will be eligible to serve as primary and secondary advisor for the postdoc. We also recently participated in a proposal to develop a United States Agency for International Development (USAID) [research and innovation fellowship](#) program (See addendum E).

Additional Activities

Faculty Development: Part of CBO's goal is to bring together faculty from diverse disciplines to apply their expertise to relevant biodiversity problems. In addition to numerous workshops and meetings, CBO invested considerable resources into disseminating research and engaging interdisciplinary faculty members and non-academics at public events and small interdisciplinary researcher networking events. Bringing interdisciplinary faculty members together has resulted in collaborations and funding opportunities including potential collaboration on a whale song project with faculty affiliate Garth Paine of the ASU School of Arts, Media and Engineering; a collaboration with faculty affiliate Selcuk Candan on the Big Data West Innovation Hub project led by the School of Computing, Informatics and Decision Systems; and development of a partnership with the Smithsonian. Additionally, we are working with faculty and administrators to devise a cluster hire proposal in interdisciplinary conservation science and policy.

Exploratory Meetings: In addition to providing seed funding and in-kind support for formal CBO projects, CBO dedicated considerable resources to exploring and developing partnerships and to engaging faculty members and practitioners on CBO Projects. CBO continues to expand its partnership with the [Central Arizona Conservation Alliance](#) (CAZCA) by coproducing events and working to leverage capacity toward shared goals. We participated in the CAZCA Earth Day and secured funding from CAZCA for the CAZCA/Central Arizona-Phoenix Long Term Ecological Research (CAP LTER) Community Wildflower Survey.

Hosted Events: We partnered with CAZCA and the DBG to bring distinguished speaker Dr. Georgina Mace to address critical biodiversity issues in conjunction with the Center's launch and we worked with faculty affiliate Ron Broglio, of the ASU English Department to present Dr. Mace in conjunction with a biodiversity art exhibit at the ASU Art Museum. In fall 2014 we partnered with GIOS Decision Center for a Desert City (DCDC) to host Dr. Joe Arvai for a seminar on structured decision-making, and we brought Dr. Jorge Torre from Mexico for a seminar on governance in biodiversity. In the spring we hosted noted herpetologist and nature writer Dr. Harry Greene for a seminar on the controversial issue of rewilding and we participated in the spring 2015 ASU Origins event. All of our events were well attended by a diverse group of academics and public with guests representing five colleges, twelve schools, and sixteen centers and organizations at ASU. Nonacademic guests represented eleven government agencies and eight non-profit organizations as well as corporations and other academic institutions. Our events illuminated critical conservation issues and prompted public and academic engagement in CBO research projects.

Year Two Objectives

Research Objectives: Key research objectives for year two include formalizing our partnership with IUCN prior to the 2016 WCC meeting where we will host an event to commemorate our partnership. We will continue developing our IUCN research projects with particular focus on providing case studies for the establishment of the new IUCN KBA standard. We will debut the Earth Genome water decision tool in December 2015 at the Paris WBCSD meeting, and pursue work on an application for biodiversity accounting. CBO will continue to support projects in its research focal areas with in-kind operational support and will consider proposals for project funding. We aim to increase proposal submissions for external funding that can support both research initiatives and CBO operations.

Education Objectives: Our education goals for the upcoming year include generating enrollment in the new certificate program, establishing a cluster hire, developing a Master's degree program, and engaging at least two diversity students from the TNC Leaf program into the undergraduate Conservation Science program at ASU. We aim to strengthen social capital at ASU for STEM diversity students by networking ASU diversity programs so that students have continuity in their diversity support as they are exposed to different programs and campuses. Additionally, CBO will strengthen ties to existing ASU biodiversity-related educational opportunities, such as those with the [Smithsonian Tropical Research Institute \(STRI\)](#) which allows faculty and students to engage in tropical conservation studies in Panama.

Faculty Engagement Objectives: We are exploring a new model for engaging faculty members in new ways by incentivizing faculty engagement via a Postdoctoral Fellow Program. CBO is partnering with TNC to support our first Nature Net-CBO Postdoctoral fellow to produce useful and impactful conservation science that advances conservation action. Fellows gain skills in transdisciplinary, use-driven science, science communication and leadership. In addition, this program aims to establish a network of fellows, university scientists, and conservation scientists that increases the scientific rigor and real world impact of work done across the network. To achieve this, we have negotiated contributions from the University, College, and Units at ASU to "match" a gift of \$46,000 from TNC to support this program. With the goal of cultivating new ideas and synergies, the Fellow will be expected to collaborate with faculty from affiliated units.

Outreach Objectives: We will increase our outreach through bringing additional visiting lecturers, developing workshops and deepening our existing partnerships while cultivating new ones. We continue to partner with schools, institutes and centers within and outside ASU. Current partnerships include collaborations on lectures and a film screening with GIOS and a partnership with the Mesa IDEA museum on an exhibit designed to enhance experiential learning about the sea for multi-generational audience.

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To achieve these objectives, we have made some changes to our organizational structure (See addendum A, Fig 2). Our education agenda, formally managed as a research focal area, is now an independent agenda that can be integrated with all areas of CBO activity including research, events, and operations. Faculty affiliate Sharon Hall is now CBO's Associate Director of Education and Diversity. Sharon will lead our education objectives as we move into year two.

Partnership Program Lead Helen Rowe accepted a position as director of the McDowell Sonoran Field Institute (MFSI), one of CBO's partners. As director for the MSFI, Helen will continue to strengthen our local partnerships and work on projects such as the IUCN Sonoran Desert Ecoregion Assessment. Director Leah Gerber and Project Manager Anita Hagy Ferguson will continue to develop and manage partnerships. As our projects or research focal areas grow to need specialized leadership, CBO will be providing summer salary to faculty affiliates to lead particular research initiatives following the leadership model we have established with Beth Polidoro for our IUCN projects.

We have hired our first postdoctoral fellow, as part of our externally-funded water decision tool development team, and we engaged in the process of hiring a Communications Coordinator to increase our education and partnership outreach, and to establish CBO as a top "go to" place for information about biodiversity, biodiversity problems and biodiversity outcomes. We are rotating new faculty onto our Advisory Board as several members rotate off which will bring new expert advisement to CBO (see addendum A, Table 4). Finally, in spring 2016 we are scheduled to move to dedicated office space in LSA and the addition of a Communications Coordinator will expand our outreach. Our expanded staff and dedicated space will allow us to scale up our research and education objectives.

Addendum A: CBO Organizational Structure

Figure 1: Organizational Chart, Year 1

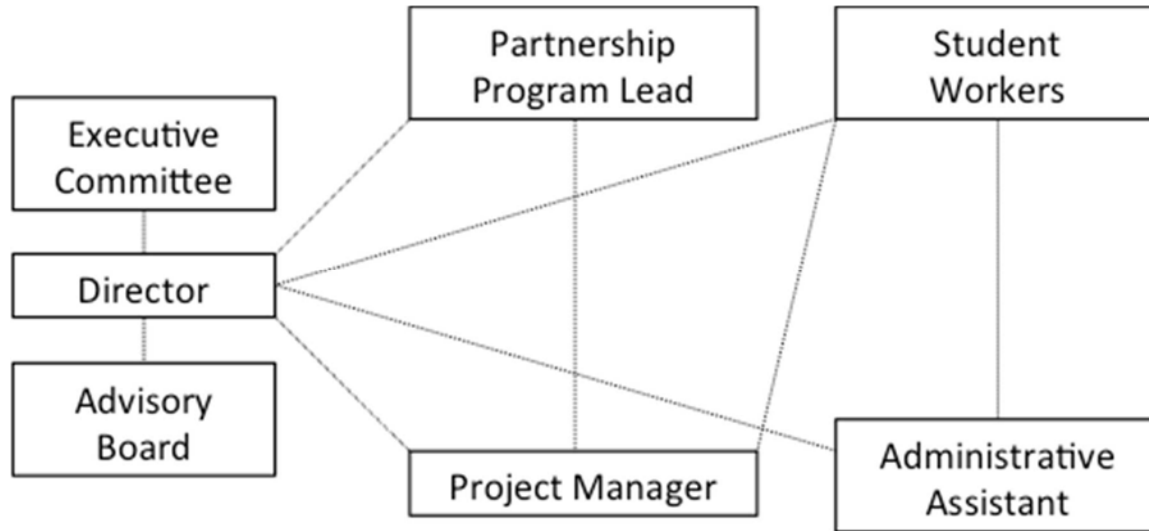


Figure 2: Organizational Chart, Year 2

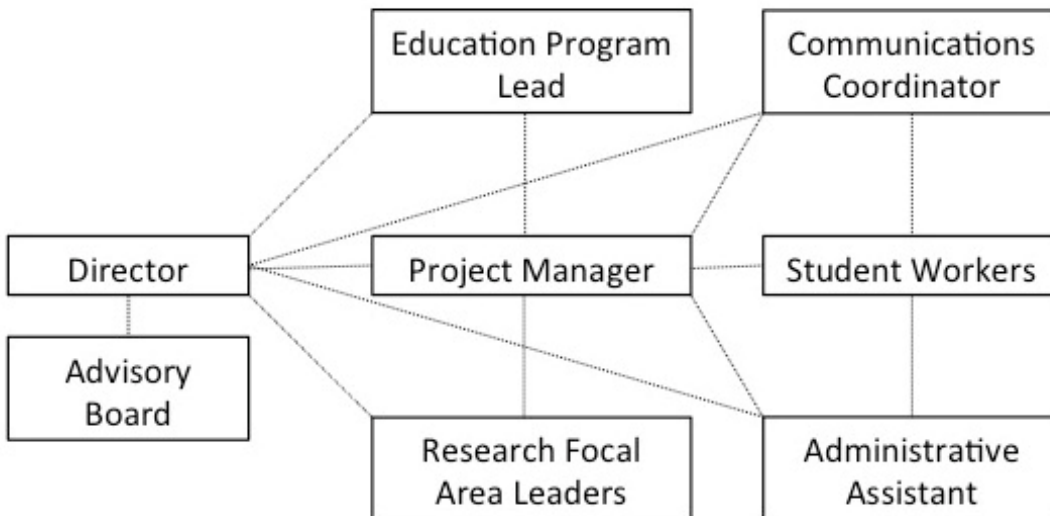


Table 1: CBO Staffing Year 1

Name	Title	Unit	CBO Title
Leah Gerber	Professor	SOLS	Director
Helen Rowe	Assistant Research Professor	SOLS	Partnerships Program Lead
Anita Hagy Ferguson	PhD Candidate	SHESC/IOS	Project Manager
Chelle Brookes	Administrative Assistant	IHO/IOS	Administrative Assistant
Sharon Hall	Associate Professor	SOLS	Director of Education and Diversity
Beth Polidoro	Assistant Professor	SMNS	IUCN Partnership Lead
Penny Langhammer	Adjunct Faculty	SOLS	IUCN KBA coordinator
Peter Breslin	PhD Student	SOLS	Graduate Services Assistant, IUCN Sonoran Desert Ecoregion Assessment
Erick Lundgren	PhD Student	SOLS	Graduate Services Assistant, IUCN Sonoran Desert Ecoregion Assessment
Sarah Geren	Masters Student	SOLS	Student Worker
Andrea Noziglia	Masters Student	SOLS	Student Worker
Caitlin Troyer	Masters Student	SOLS	Student Worker
Cassandra Clement	Undergraduate Student	SMNS	Student Worker
Kyle Strongin	PhD Student	SOS	Student Worker
Brenna Corley	Undergraduate Student	SMNS	Student Worker
Nathan Muniz	Undergraduate Student	SOLS	Student Worker
Bria Pogue	Undergraduate Student	SOLS	Student Worker
Susan Soto	Undergraduate Student	SOLS	Student Worker
Sechindra Vallury	PhD Student	SOS	Student Worker
Neda Movehed	Masters Student	SOS	Student Worker
Ute Brady	PhD Student	SHESC	Student Worker
Jaishri Shrinivasan	PhD Student	SOS	Student Worker

Table 2: CBO Staffing Year 2

Name	Title	Unit	CBO Title
Leah Gerber	Professor	SOLS	Director
Anita Hagy Ferguson	PhD Candidate	SHESC/IOS	Project Manager
Chelle Brookes	Administrative Assistant	IHO/IOS	Administrative Assistant
TBD	Communications Coordinator	IOS	Communications Coordinator
Sharon Hall	Associate Professor	SOLS	Director of Education and Diversity
Beth Polidoro	Assistant Professor	SMNS	IUCN Partnership Lead
Penny Langhammer	Adjunct Faculty	Contractor	IUCN KBA coordinator
Hongkai Gao	Post Doc	IOS	EG water decision support tool Postdoc
TBD	Post Doc	IOS	NatureNet Postdoc Project TBD
Peter Breslin	PhD Student	SOLS	Graduate Services Assistant, IUCN Sonoran Desert Ecoregion Assessment
Erick Lundgren	PhD Student	SOLS	Graduate Services Assistant, IUCN Sonoran Desert Ecoregion Assessment
Sarah Geren	Masters Student	SOLS	Student Worker
Marielle Abalo	PhD Student	SOLS	Graduate Services Assistant
Yaiyr Astudillo-Scalia	PhD Student	SOLS	Graduate Services Assistant

Table 3: CBO Advisory Board Year 1

Name	Title	Unit
James Collins	Professor	SOLS
Sharon Hall	Associate Professor	SOLS
Charles Perrings	Professor	SOLS
Beth Polidoro	Assistant Professor	SMNS
Osvaldo Sala	Professor	SOLS
Dan Sarewitz	Professor	SOLS/CSPO
Mike Schoon	Assistant Professor	SOS
Andrew Smith	Professor	SOLS
Abby York	Associate Professor	SHESC

Table 4: CBO Advisory Board Year 2

Name	Title	Unit
Rolf Halden	Professor	FSE
Minu Ipe	Professor	WPC
Rob Melnick	COO, Dean, Professor	GIOS
Charles Perrings	Professor	SOLS
Osvaldo Sala	Professor	SOLS
Dan Sarewitz	Professor	SFIS
Andrew Smith	Professor	SOLS
B.L. Turner	Professor	SGSUP
Abby York	Associate Professor	SHESC

Table 5: CBO Executive Committee Year 1*

Name	Title	Unit
Rob Melnick	COO, Dean, Professor	GIOS
Gary Dirks	Director	GIOS
Ferran Garcia-Pichel	Dean of Natural Sciences	CLAS
Brian Smith	Director (outgoing)	SOLS
Bert Jacobs	Director	SOLS

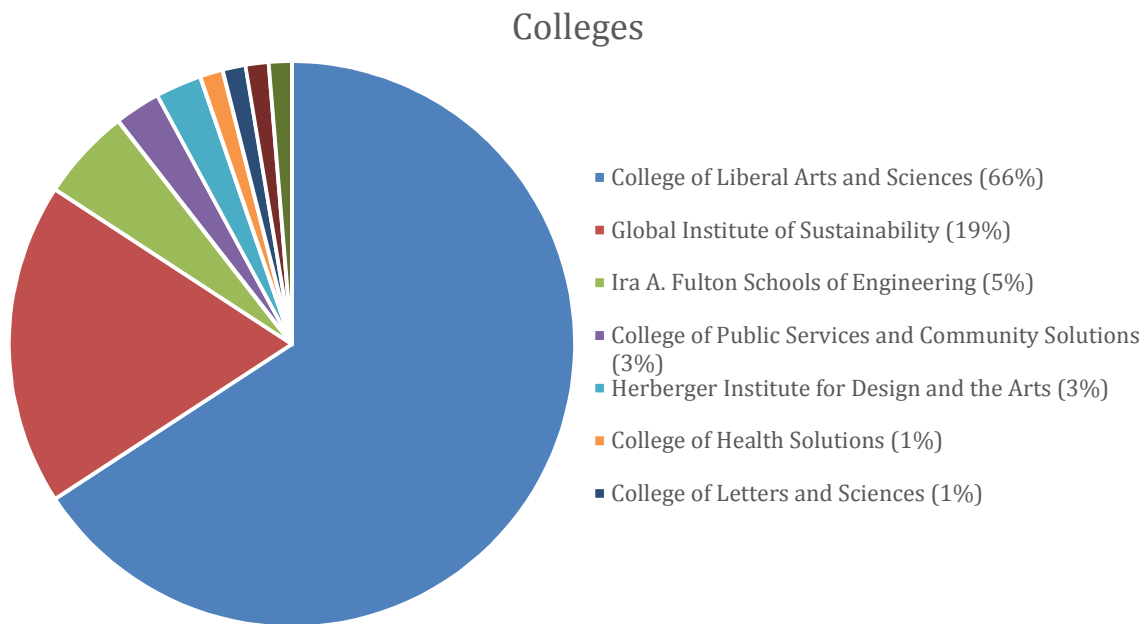
Table 6: CBO Operations Committee Year 1*

Name	Title	Unit
Candice Carr Kellman	Assistant Director	SOS
Marcia Nation	Project Manager	CAP-LTER
Kevin Reinhart	COO, Dean, Professor	GIOS
Patricia Reiter	Executive Director	WSSI
Meredith Simpson	Chief of Staff	GIOS

*Executive and Operations committees were dissolved in CBO's first year.

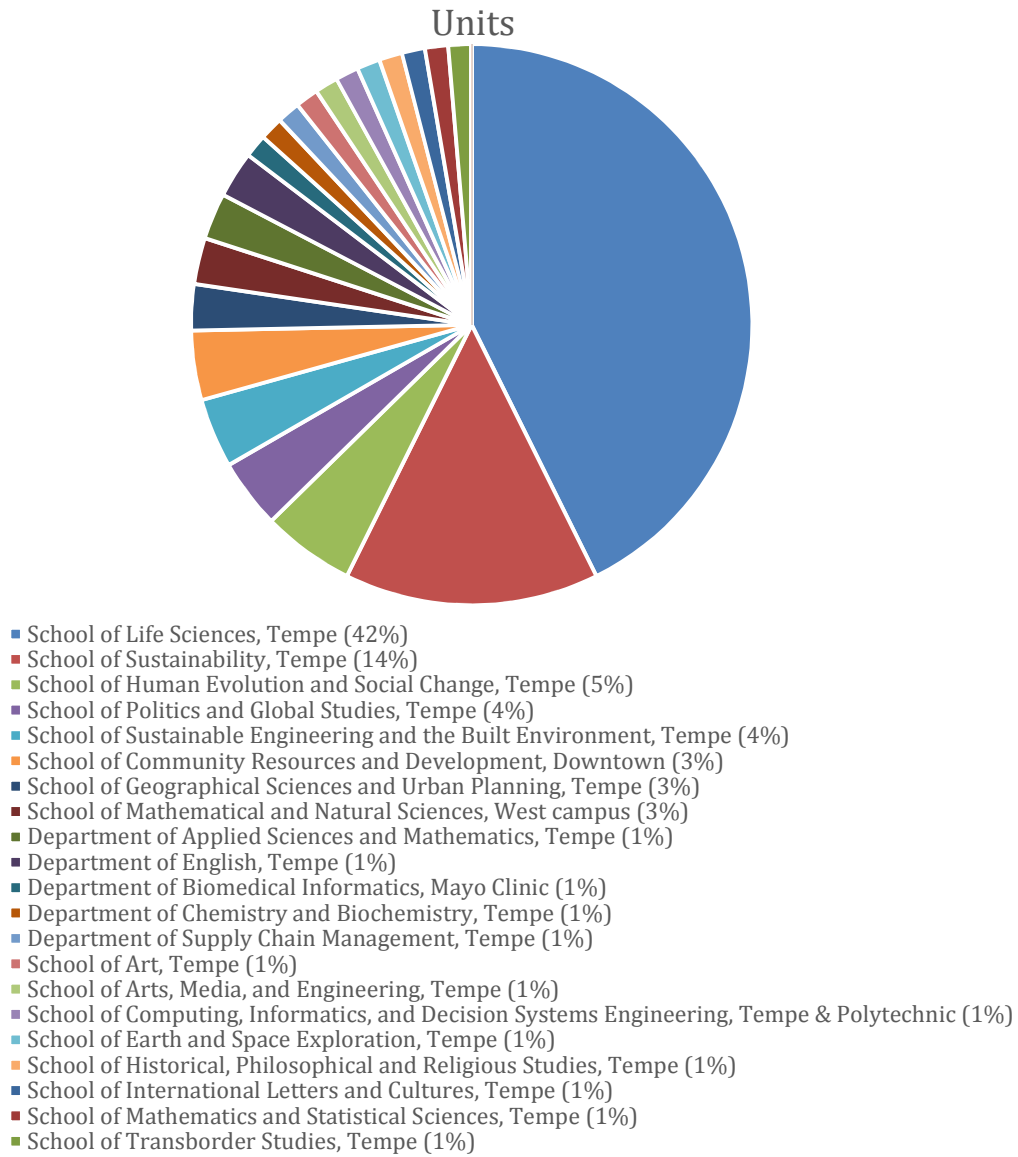
Addendum B: CBO Faculty Affiliates

Figure 3: College and university level representation for CBO affiliates.



In year 1 CBO established affiliate relationships with 77 faculty members across ASU. The better part of our representation is in the College of Liberal Arts and Sciences, at 66% with another 19% representation from the Julie Ann Wrigley Global Institute of Sustainability. The remaining 15% came from other colleges or university level centers and institutions.

Figure 3: Unit level representation for CBO affiliates.



A diversity of units engaged with CBO. 42% of our affiliates were in the School of Life Sciences, 14% were in the School of Sustainability and 5% were in the School of Human Evolution and Social Change. The remaining 39% of affiliates represent a diversity of disciplines and units. CBO aims to increase involvement from humanities, business and law in order to optimize cross-disciplinary understanding of biodiversity issues and collaboration in outcome-based research.

Addendum C: Activities

Table 7: Focal Area Research Projects

Research Project	Research Focal Area	Project Leads	ASU Units Represented	Partners	External Funding
Biodiversity Assessment	Biodiversity assessment & decision tools	Beth Polidoro Andrew Smith	SMNS SOLS	DBG; IUCN; PHX Zoo; SNAP; TNC;	\$125,000 SNAP
Structured decision-making and the Endangered Species Act	Biodiversity assessment & decision tools	Leah Gerber	SOLS	ERB; FWS; SESYNC	\$85,000
Developing a data driven decision support tool for corporate decision making in water	Advancing corporate sustainability	John Sabo Ben Rudell	SOLS FSE	EDF; EG; WBCSD	\$100,000
Biodiversity Accounting	Advancing corporate sustainability	Leah Gerber	SOLS	BC; IUCN; EDF; EG; SNAP; TNC; WBCSD	<i>Pending</i>
Collaborative Governance for Improving Biodiversity Outcomes	Governance & biodiversity	Mike Schoon	SOS	PECS; TNC	<i>Pending</i>
Renewable energy and biodiversity planning	Governance & biodiversity	Abby York Clark Miller	SHEHC SFIS	BLM; TNC	<i>Pending</i>
Decision-support and coastal protection system to cope with <i>Sargassum</i> invasions in the Mexican Caribbean	Governance & biodiversity	David Manuel-Navarrete	SOS	CINVESTAV; COBI; USABCS	<i>Pending</i>
Actionable Science, boundary organizing and co-production of biodiversity outcomes	Governance & biodiversity	Anita Hagy Ferguson Clark Miller	SHEHC; GIOS SFIS	PEW; SESYNC; NCEAS-SNAP; USGS;	<i>Pending</i>
Infectious diseases, synthetic biology, and the two faces of extinction project	Public Health & Biodiversity	James Collins	SOLS	Proposed: CDC; IPCC; IUCN; OIE; WHO	<i>Pending</i>
Impact of microplastics on human health and the environment	Public Health & Biodiversity	Rolf Halden Beth Polidoro	CES SMNS	SPREP	<i>Pending</i>
Environmental and human health effects of contaminants in wastewater dominated streams.	Public Health & Biodiversity	Rolf Halden Matthew Scotch	CES CES	EPA; USGS	<i>Pending</i>

CBO supports research partnerships that harness joint capacity to develop innovative solutions to biodiversity challenges. Both consumers and producers of knowledge collaborate to identify and pursue research questions that will lead to use inspired research and action. Our initial research focal areas include: 1) Biodiversity assessment and decision tools; 2) Advancing corporate sustainability; 3) Governance and biodiversity; 4) Public health and biodiversity.

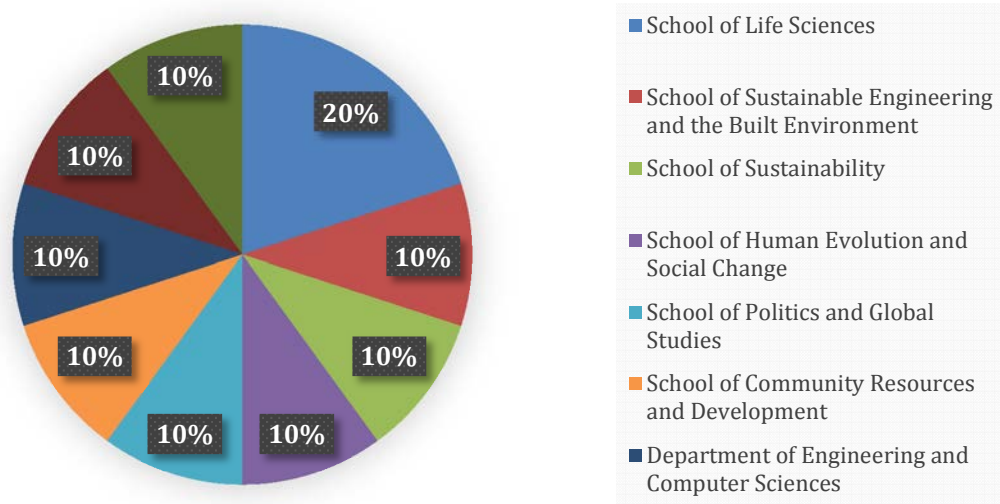
Table 8: Education Research Projects

Education Project	Project Type	Project Leads	ASU Units Represented	Partners	External Funding
Broadening diversity in biodiversity science	Education initiative	Sharon Hall Anita Hagy Ferguson Gabriel Escontrias	SOLS SHESC; GIOS CGEST	TNC, NOAA; NWF, ESA, UM, UW; YSFES	<i>Pending</i>
Engaging Native Hawaiian underserved youth in research and outreach education	Education Research	Yaiyr Astudillo-Scalia Leah Gerber	SOLS SOLS	LHA; NOAA; WT	<i>Pending</i>
Transnational long-term analysis of local effects of climate change	Education Research	Leah Gerber Monica Elser	SOLS GIOS	COBI; PN; NSF-PIRE; USF	\$1,500,000 finalist, not awarded

CBO has partnered with several external organizations to offer a variety of fellowships to graduate students and Post docs. The McDowell Sonoran Conservancy Biodiversity Fellowship will be awarded for the 2015-2016 academic year award in the amount of \$12,000 per year to a graduate student. The Huizingh Desert Research Fellowship, co-funded by the DBG, provides five years of funding for a PhD student. The prestigious NatureNet Science Fellows Program will provide support for early career scientists to conduct research at the interface of science, technology and business in order to achieve biodiversity outcomes. CBO has a pending application to develop a United States Agency for International Development (USAID) research and innovation fellowship.

Addendum D: Unit-level representation for CBO research project leads.

Project Leads on CBO Research



The Center for Biodiversity Outcomes strives to create interdisciplinary research. To this end our research projects are led by faculty from array of backgrounds and knowledge sets, promoting development of novel ways to apply theory and methodology. Project leads represent 8 different departments within ASU and two other ASU centers, the Decision Center for a Desert City and Center for Environmental Security in the Biodesign Institute.

Addendum E: Funding

Table 9. Summary of grant activity for CBO.

Project	Grantor	Amount	Status	Awarded
Endangered Species Act decision making	National Socio-Environmental Synthesis Center (SESYNC)	\$85,000	Awarded	\$85,000
Decision support tool for corporate decision making in water	The Earth Genome	\$100,000	Awarded	\$100,000
Analysis of humpback whale reproductive hormones	Maui Whale Trust	\$2500	Awarded	\$2500
Ecosystem services and key biodiversity Areas	Science for Nature and People (SNAP)	\$200,000	Awarded	\$125,000
Resilience of Social-Ecological Systems Under the Stress of Shale Oil and Gas Production	National Science Foundation Dynamics of Coupled Natural and Human Systems (NSF CNH)	\$170,899	Pending	\$0
NatureNet Science Fellowship	The Nature Conservancy	\$46,000	Awarded	\$46,000
Transnational long-term analysis of local effects of climate change	Pacific Institute for Research and Evaluation (PIRE)	\$1,500,000	Finalist/Not Awarded	\$0
Sustainably Communities and Place-based Education (SCAPE)	Environmental Protection Agency Environmental Education Mode	\$192,000	Not Awarded	\$0
TOTAL SOLICITED		\$2,296,389		
TOTAL AWARDED				\$358,500

Table 10: Fellowships

Fellowship	Level	Units	Partners	Amount
Huizingh Desert Research Fellowship	PhD	SOLS	DBG	5 years funding
McDowell Sonoran Conservancy Biodiversity Fellowship	PhD	SOLS	MSC	\$6000 Matched by ASU
Nature Net Science Fellowship	Postdoc	OKED; GIOS (SOS); CLAS (SFIS; SHESC; SMNS; SOLS; SESE)	TNC	\$46,000 Matched by ASU
USAID Research and Innovation Fellowship	Masters or PhD	GIOS	USAID	<i>Pending</i>

CBO has partnered with several external organizations to offer a variety of fellowships to graduate students and Post docs. The McDowell Sonoran Conservancy Biodiversity Fellowship will be awarded for the 2015-2016 academic year award in the amount of \$12,000 per year to a graduate student. The Huizingh Desert Research Fellowship, co-funded by the DBG, provides five years of funding for a PhD student. The prestigious NatureNet Science Fellows Program will provide support for early career scientists to conduct research at the interface of science, technology and business in order to achieve biodiversity outcomes. CBO has a pending application to develop a United States Agency for International Development (USAID) research and innovation fellowship.

Addendum F: Year One Action Plan, Objectives and Milestones (2014 CBO Strategic Plan).
All objectives and milestones were achieved for year 1.

Objective 1: Establish 2-4 Research Focal Areas

Milestone 1a. Research Focal Areas Topics and Project Leaders are identified

Milestone 1b. Hold Advisory Board retreat

Milestone 1c. Research Focal Area activity

Objective 2: Each Research Focal Area identifies and engages stakeholders in the co-production of knowledge

Milestone 2a. Identify existing and potential partnerships related to biodiversity and possible synergies and leveraging with CBO

Milestone 2b. Prioritize and engage with partners within Research Focal Areas

Milestone 2c. Identify partner needs, research project ideas, and sources of external funding

Milestone 2d. Each Research Focal Area submits at least one proposal for external funding.

Objective 3: Develop student opportunities within research Focal Area areas

Milestone 3a. Develop 2 new Biodiversity Fellowships with stakeholders that will contribute to the research Focal Area activity

Milestone 3b. Develop internship and research opportunities for undergraduate students with stakeholders that will contribute to the Research Focal Area activity.

Objective 4: Establish new certificate program

Milestone 4a: Develop list of courses to include, complete proposal

Milestone 4b: Gather required letters of support

Milestone 4c: Submit proposal in Fall 2014

Objective 5: Seminars and Workshops

Milestone 5a. Research focal area project leaders invite individuals to campus as part of their research partnership activity.

Milestone 5b. CBO will develop events around these visits.

Objective 6: Develop Research Focal Area hiring plan for CBO

Milestone 6a. Advisory Board develops vision for a CBO hiring plan

Milestone 6b. CBO will facilitate developing the cluster hire plan by identifying the hiring committee, schedule committee members, and facilitate progress towards goals

Milestone 6e. Hiring plan is compiled and submitted.

Objective 7: Identify space needs and opportunities for CBO

Milestone 7a. Identify number of offices, conference rooms needed.

Objective 8: Secure external funding for long-term operations

Milestones 8a. Identify potential funding sources (e.g. foundations, corporations)

Milestone 8b. Assess which CBO programs and focal areas may fit with various RFPs

Milestone 8c. Submit research proposals

Addendum G: Logic Model; Activities, Outputs and Outcomes – Years 1 and 2 (2014 CBO Strategic Plan)

	Activities Years 1 & 2	Outputs	Short-term Outcomes Years 1 & 2	Medium-term Outcomes Years 3 & 4	Impacts Years 5+
Research	<ul style="list-style-type: none"> • Invite ASU researchers to affiliate with CBO • Engage CBO community through meetings, coffee hours, and seminars with biodiversity thought leaders • Promote biodiversity research at ASU through listing existing projects on CBO website • Map ASU biodiversity research community • Support 3-4 projects within 2-4 multi-disciplinary focal areas • Respond to external funding RFPs related to biodiversity research –at least 1 per focal area • Create collaborative research projects with non-academic partners (non-profits, government entities, private sector) • Initiate “research to policy/decision-making” dialogues with CBO community • Support research focal areas by funding travel for visiting speakers 	<ul style="list-style-type: none"> • Number of projects supported by CBO • Number of researchers affiliated with CBO • Number of meetings hosted with partners • Attendance at seminars • Number of collaborating projects on CBO website • Number and \$ amount of external grant proposals facilitated through CBO • Number of non-academic collaborators • Number of meetings and projects that promote research to policy dialogue 	<ul style="list-style-type: none"> • Creation of a visible multidisciplinary biodiversity research community at ASU • Broader dialogue at ASU on biodiversity and sustainability • New multidisciplinary and multi-field research collaborations • Co-creation of knowledge with non-academic collaborators toward biodiversity outcomes • Increased resources for selected biodiversity research at ASU • CBO affiliated biodiversity projects articulate implications for decision-making and public policy 	<ul style="list-style-type: none"> • Increased capacity at ASU for societal engagement and biodiversity solutions • CBO becomes the go-to entity in Arizona for information on biodiversity and decision-making • Partner organizations begin to incorporate sustainability perspectives into biodiversity plans • Major grants fund biodiversity research and initiatives that link research to decision-making • Publications establish ASU’s growing prominence in developing new approaches to biodiversity 	<ul style="list-style-type: none"> • Funding for CBO affiliated efforts exceeds \$5 million • CBO becomes self sustaining within 5 years • CBO informs biodiversity management at local, national, and global scales • CBO is nationally known for multidisciplinary biodiversity research and bridging different groups to work on biodiversity issues • CBO improves scientific support for international agreements • CBO forwards new approaches to conservation and an appreciation of governance in biodiversity management
Education	<ul style="list-style-type: none"> • Work with partners to develop internship and other learning opportunities for 	<ul style="list-style-type: none"> • Number of interns 	<ul style="list-style-type: none"> • Interns and fellows demonstrate putting biodiversity 	<ul style="list-style-type: none"> • Increase in number of undergraduate and graduate students 	<ul style="list-style-type: none"> • Students engaged in biodiversity-related courses &

	<p>undergraduate students with a focus on underrepresented groups</p> <ul style="list-style-type: none"> • Develop biodiversity graduate fellowships • Establish certificate in Science Communication and Leadership • Develop new professional MS degree • Work with CBO affiliated faculty to strengthen the delivery of undergraduate courses with biodiversity content • Promote biodiversity-related courses for students at ASU • Include faculty teaching biodiversity-related courses as CBO affiliates • Promote integration and knowledge sharing among faculty teaching biodiversity-related courses • Facilitate development of cluster hire plan by identifying the hiring committee, scheduling committee meetings and facilitating progress toward goals 	<ul style="list-style-type: none"> • % of interns from under-represented groups • Number of fellowship recipients • Enrollment nos. in certificate program • Enrollment nos. in professional MS degree • New courses, enrollment in new courses (including ASU online) • Number of courses with enhanced content • Number of students reached with information about biodiversity courses • Number of faculty involved in CBO • Number of faculty hires 	<p>knowledge into practice</p> <ul style="list-style-type: none"> • Students express interest in biodiversity –related careers • Increase in number of graduate students pursuing biodiversity research with CBO partners • Undergraduate courses include active learning and project/problem-based learning • Students increase knowledge about science communication and leadership • Increased visibility for biodiversity-related courses at ASU • Improved communication among faculty teaching biodiversity-related courses • Faculty hired for biodiversity-related positions have research and teaching foci relevant to CBO 	<p>taking courses with biodiversity content</p> <ul style="list-style-type: none"> • Graduates from biodiversity-related programs at ASU continue education on biodiversity-related topics or enter biodiversity-related careers • Biodiversity-related courses coordinated across disciplines • Multidisciplinary education on biodiversity issues emerges as a strength at ASU 	<p>internships have higher rates of graduation than ASU as a whole</p> <ul style="list-style-type: none"> • New ways to increase student retention in biodiversity science • Competency in science communication seen as critical for students pursuing biodiversity-related degrees • ASU becomes nationally known for multidisciplinary biodiversity education programs • Graduates from biodiversity-related programs at ASU enter workforce and connect CBO to more partners
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Engagement	<ul style="list-style-type: none"> Engage high school students in learning about biodiversity-related courses at ASU through science festivals and STEM public events Involve graduate students affiliated with CBO to talk to high school students (i.e. in environmental education clubs) about biodiversity education at ASU Identify and invite biodiversity and conservation oriented organizations to affiliate as partners with CBO Involve partners in CBO events Create collaborative research projects with non-academic partners (non-profits, government entities, private sector) Identify partnership opportunities for public engagement in biodiversity 	<ul style="list-style-type: none"> Number of high school students reached through events and communication Number of organizations affiliated with CBO Number of partners at events Number of partners involved in projects Number of partners offering internships and learning opportunities 	<ul style="list-style-type: none"> Increased awareness about opportunities to take courses on biodiversity at ASU Increase in number of CBO partners Partners value student involvement in their programs Partners contribute to shaping CBO research agenda CBO faculty increase understanding about linkages between research and decision-making 	<ul style="list-style-type: none"> Increase in number of undergraduate students taking courses with biodiversity content Partners increase engagement in CBO activities, including internships, research projects, and policy efforts CBO partners with more national and international organizations Partner organizations begin to incorporate sustainability perspectives into biodiversity plans CBO becomes the go-to entity in Arizona for information on biodiversity and decision-making 	<ul style="list-style-type: none"> Number of students graduating with majors, certificates, minors, and emphases in biodiversity-related programs hits all-time high CBOs work with partners results in selected changes in planning and decision-making on biodiversity issues CBO establishes reputation locally, nationally, and internationally for multidisciplinary approaches to conservation and biodiversity that include sustainability CBO improves environmental literacy in underserved communities.
Operations	<ul style="list-style-type: none"> Secure external funding for long-term operations Engage donors through fundraising events with visiting speakers Develop portfolio of opportunities at CBO Identify space needs and renovate space for CBO 	<ul style="list-style-type: none"> Number of Donors engaged Money raised Donor network reach ASU funding commitment renewed each year 	<ul style="list-style-type: none"> CBO has established relationship with key donors and development team members at ASU Foundation CBO locates money internally at ASU for center space renovation 	<ul style="list-style-type: none"> CBO raises money to support research through private donations CBO raises money to support CBO operations through private donations 	<ul style="list-style-type: none"> Become a self-sustaining center CBO raises money to support capital needs through private donations