The Rocky Mountain Biological Laboratory

The Rocky Mountain Biological Laboratory (RMBL) advances the scientific understanding of nature that promotes informed stewardship of the Earth. Science conducted at the Lab is remarkable for its combination of diversity and depth. Founded in 1928 as an independent field station with no institutional affiliation, the Lab hosts one of the largest gatherings of field biologists with scientists flocking to Gothic from institutions across the world. Internationally recognized research has been done at all levels of organization from gene to ecosystem, and Lab scientists have produced over 1300 publications. Several scientists have spent entire careers working at the Lab; quite a few projects extend 30+ years. The combination of research breadth and intensively studied systems make the high-altitude ecosystem surrounding the RMBL one of the best understood anywhere.

Science conducted through the RMBL influences environmental policy. Research on acid deposition was used during revision of the National Clean Air Act to protect air in the western US. Studies of climate change, pollination biology, and invasive plants have recently influenced policy. Particularly influential scientists who have worked at the Lab include Dr. Paul Ehrlich, author of *The Population Bomb*, Dr. Michael Soule, founder of Conservation Biology, Dr. John Holdren, President Barack Obama's National Science Advisor, and Dr. Theo Colborn, author of *Our Stolen Future*.

RMBLNet

Recent improvements in sensing technology allow scientists to collect environmental information on temporal and spatial scales that were previously unrealistic to study. The RMBL has received a National Science Foundation grant for $473,800 to install five permanent weather stations along an elevational gradient. These weather stations monitor temperature, wind, precipitation, snowpack, solar radiation, soil moisture, video, and audio. The ability to track these parameters on a continuous and year-round basis fundamentally improves the ability of scientists at the RMBL to study how organisms interact with the environment.

These weather stations were installed in 2009. Three of them are located on property managed or owned by the RMBL and 2 are on US Forest Service lands. Each site has its own unique power and communications solution. We are in the process of developing a public website portal, but eventually the general public will have full access to real-time data (except for one remote station where data transmission is more challenging).

This project is designed for the long-term. The longer the stations collect data, the more valuable the sites will become. We have designed the installations in a manner that allows scientists to integrate field research projects with the weather stations, either by locating projects in proximity to the stations, or by the use of portable weather stations that allow scientists to link a research site to the network of permanent stations. At least one new scientist has been attracted to the RMBL because of the weather stations and several scientists have initiated projects in proximity to the station, including a project involving long-term monitoring of pollinators. Consequently we anticipate that the weather stations will both attract new scientists, as well as expand the range of questions that the scientists can pursue.

Incorporating the Roaring Fork Watershed into RMBLNet

Installing a permanent weather station as part of the RMBL network will have a number of advantages for the RMBL and the Roaring Fork Watershed (RFW). The most obvious benefit will be generation of

long-term weather data that can be used to understanding the RFW. By tapping into the RMBL's data management system and taking advantage of our in-house expertise, we can accomplish a fairly complex project in a cost effective manner.

The benefits of establishing a weather station site that is integrated with the RMBL network extend beyond data collection. Such an installation would provide an opportunity for the Aspen Field Biology Laboratory (AFBL) to leverage RMBL's reputation and expertise to attract research into the Aspen area. While the project does not involve directly supporting scientists, it is a cost effective way to make the Aspen area attractive to research. The focus of most weather stations is solely to track long-term data; stations installed as part of the RMBL network are unique in that they are designed to be integrated with field work. Consequently the weather station will serve as a cost-effective beacon for attracting field scientists. Additionally, because of the Lab's profile, the weather station will attract the attention of scientists that might otherwise not be aware of it.

Proposal

Installing a weather station requires solving a series of logistical issues and it is difficult to know the full costs of installation until those issues have been resolved. Because much of the scientific value of this project involves identifying a site that can serve a weather station for decades, and making certain that the site allows integration of the weather station with field research, careful planning is essential. We are requesting $12,000 to conduct a feasibility analysis of establishing a permanent weather station in the RFW. The feasibility analysis will generate a report that includes the following items:

1. A systematic review of existing weather installations in the Roaring Fork Watershed;
2. Identification of potential partners in the project, with an analysis of how those partners might support and benefit from the project.
3. Identification of up to 3 potential sites for installation, including identifying site-specific issues, such as permission, power, access, communications, potential to accommodate long-term research, and scientific value of the location given existing weather stations and scientific needs;
4. Descriptions of three potential installation packages, including an analysis of the scientific values, costs, and logistical issues associated with each installation package;
5. A timeframe and budget for installation, as well as a budget for long-term maintenance;
6. A plan for long-term curation of the data generated by the weather station.

Timeframe

Week of February 1: Initial Conference Call with AFBL representatives to discuss sensor packages, identify site considerations, discuss individuals/groups to contact, and discuss potential sites.

Month of February: Discussions with interested parties concerning sensor packages and possible locations. Identify existing weather stations and locations.

Week of March 1: Conference call with AFBL and interested parties to review potential sites and sensor packages. This could be done as a meeting in Aspen. **Bringing RMBL staff over (RMBL ED and Project Manager Dan Jones) and having the RMBL organize the meeting would add another $1,500 in costs and would be in addition to the $12,000.**

Mid-April: Site visit to Aspen to conduct inspection of sites remaining on short list and identify any remaining issues.

April 30: Finalize budgets for remaining sites. Finalize potential sensor packages.

May 15: Final report to AFBL.

Initial Estimate of Installation and Maintenance Costs

A significant part of the assessment will be to estimate the costs of installation and maintenance. The exact costs will depend upon the installation package that is chosen, the timing of installation, and site-specific issues (e.g., whether a foundation needs to be installed or whether the tower can be bolted into existing bedrock). In order to provide a sense of the potential range of costs, we present some preliminary numbers for installation of a single station.

Installation package: $30,000-$60,000.
Labor associated with installation (2 individuals, $30/hr and $15/hr): $1500-$4500
Excavation (hand digging or backhoe): $500-$2500
Installation of sensors by technician and follow-up ($50/hr): $1,000-$7,500
Initial data management ($75/hr): $1,000-$5,000
Project management and overhead (50% of installation costs): $18,000-$40,000
Annual equipment budget: $1,500 -$3,000 (5% of installation package)
Annual personnel costs for maintenance of station: $1,500
Annual communication costs: $500-$1,000 (depending up location)
Annual data curation costs: $600 - $3,000 ($75/hr, depending upon number of field data sets)

Building Collaborations

A significant part of this proposal will be to establish collaborations with groups in Aspen that would benefit from the project. These collaborations will serve several different functions. First, in order to ensure we maximize the scientific value of the weather station, we need to understand what various groups who are interested in data currently desire, both in terms of location and the sensor package. Second, working with other groups will help us implement the project in the best possible location. Installation on public lands is problematic because the federal government will require a NEPA review. While we can pursue that option if necessary, ideally we can find private property in a good location. Having such a partner would reduce our installation costs, shorten the time needed to install, and increase the value of the project. Finally, there are substantial educational opportunities associated with weather stations, and engaging groups early in the process maximizes opportunities to design the project in a way that students will benefit.

We will establish collaborative relationships by identifying interested partners early in the planning phase of the project. We will work with AFBL to identify potential partners, as well as work with our own contacts. We will conduct a series of individual conversations with those partners to make them aware of the project and to identify how they might benefit from the project. Additionally, we can hold a meeting in Aspen in order to bring interested parties together and generate additional interests in the project.

Summary

This project is an exciting opportunity to explore a potential collaboration between the RMBL and the AFBL. Installing a weather station will generate useful information for the RFW and serve as a cost effective means for attracting future research, both by bringing the RMBL into the watershed as well as attracting scientists who wish to take advantage of the weather data. From the RMBL perspective, it increases the geographic range in which we will be collecting weather data and provides additional opportunities for our scientists. Additionally, this project may provide opportunities for the RMBL to solidify the financial support needed for long-term maintenance of the weather stations.