Mountain Meadows Health Assessment Protocol for use by Watershed Groups and Citizen Monitors

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Introduction

Montane meadows are a distinct wetland habitat, usually centered on small permanent or intermittent streams. They consist of openings in forested lands that range in size from a few hundred square meters to several square kilometers but have considerable stability in size and place through time (Benedict 1984). Their high water tables (< 1 meter) exclude most trees, resulting in relatively low-growing vegetation. Meadows are usually dominated by sedges and rushes, although stream banks are often lined with willows and alders. The sedges have extraordinarily long and dense root and rhizome networks that produce a sod that is inherently resistant to erosion. This helps to maintain wet soils through much of the summer because these root mats act like sponges, keeping water available for all of the surrounding plants. The combination of readily available moisture and lack of shading provides ideal habitat for many plants that do not occur elsewhere. Plant species are extremely diverse within individual meadows and across meadow types (Ratliff 1985, Debinski et al. 2000).

Diversity of animals is also high. During summer months, montane meadows are considered the single most important habitat in the Sierra Nevada for birds (Graber 1996). Streams flowing through these meadows are productive habitat for trout and other fishes and contribute significantly to fisheries (Moyle et al. 1996). In addition, mountain meadows are believed to play an important role in regulating water quality, maintaining summer flows, and attenuating flooding. Because of their rapid response to changing conditions compared to surrounding forests, due to fragile vegetation, high water table, and soft soils, they can also be useful as indicators of climate change (Debinski et al. 2000).

Within mountain meadows, the historical pattern of destructive land use practices by a variety of anthropogenic impacts such as mining, water diversion, agriculture, grazing and timber harvest since the 1850s, and an ever-growing human population have increasingly stressed aquatic organisms and their habitats. There is surprisingly little comprehensive information available regarding meadows, or the status of the streams they contain on which to base conservation priorities. This is presumably because they are comparatively resilient systems that can return to an apparent high state of ecological function once degrading influences, such as grazing or roads, are eliminated or reduced. (Ratliff 1984, US Bureau of Land Management 1995). In developing this protocol, we have attempted to address critical information gaps and deepen our understanding of the connections between instream and terrestrial conditions in meadows.

With few exceptions, nearly all of the meadows in the Sierra Nevada have been grazed by livestock at one time or another Some areas have been badly damaged by overgrazing and the effects can still be seen in many of the meadow streams in the Sierra Nevada. In the Sierra Nevada mountain range of California, grazing was virtually ubiquitous before 1930 and only the most remote and inaccessible areas remained ungrazed. Grazing occurred primarily in riparian areas because they provided the best forage, shade, and easy access to water, but the effects of such overgrazing quickly became evident (Kinney 1996, Kattelmann and Embury 1996).

This Meadows Health Assessment protocol was originally developed by UC Davis scientists to provide a rapid bioassessment of meadows in the Sierra-Nevada. SYRCL first tested the draft protocol with volunteers in 2007, and, working with Sabra Purdy and scientists of the Natural Heritage Institute, provided this version to enhance the capacity for citizen groups to implement the protocol while preserving the original scientific basis.

This revised protocol is designed to enable assessment of multiple meadows by a small crew within a two week period. Although some expertise in ecology is important for training and interpretation of data collected, the protocol can be implemented by volunteers and people with limited experience. While not highly quantitative, the protocol does allow for assessing relative health and condition of meadows within a region, and also detection of trends in meadow health. While it is ideal if the same crews gather data for all meadows to be compared, the protocol can implemented as part of a program that selects different meadows for assessment each year to provide expanding coverage. In addition, meadows can be re-assessed by this protocol every five years or so in order to monitor trends.

Preparing for Meadow Surveys

A. Recruit and Train Citizen Meadow Monitors

1. Recruit volunteers who can commit for the entire series of meadows to be assessed. The experience and continuity of volunteers is helpful for training purposes, as well as supporting efficient coordination of sampling.
2. Produce field data sheets appropriate to sample parameters and the meadow protocol.
3. Provide a glossary of terms, understanding of meadow hydrologic function, and natural history of Sierra meadows.
4. Divide the training group into teams focusing on intensive training in specialty subjects:
    a. Physical and Chemical Data, In-Stream Measurements
    b. Reptiles, amphibians
    c. CBMP Macroinvertebrate ID and collecting procedures
    d. Riparian Vegetation ID and % Cover Estimations
    e. Soil Testing
    f. CBMP Habitat Rapid Bioassessment P-Hab Metric, relevant to meadows
    g. Review safety concerns and procedures …

B. Site Selection

1. Identify candidate meadow Sites in your watershed. Note relative size, geology, elevation, potential health issues, and causes of impacts
2. Investigate and describe accessibility. Consider ease of carrying equipment and permission required to cross or enter private land.
3. Select XX Meadows based on project goals.

C. Gather necessary equipment

1. 50 Meter Measuring Tape, flagging tape
2. BMI equipment: D kick net, two white sample trays, magnifiers, ice cube tray, forceps, ethanol, jars and lids, rite in the rain labels, BMI ID guidebook
3. Herp net, guidebook
4. John Laws Muir Guidebook
5. Vegetation keys, hand lens, soil auger
6. Data sheets for all parameters on rite in the rain paper; pencils, sharpies
7. GPS units, compass and maps of each site
8. Chemical sampling equipment: DO kit, Waste bottles, pH, TDS, Air Temperature meters, Yogurt jug, Velocity meter, orange, watch

9. Digital camera
10. First Aid Kit, sunscreen, insect repellant, lunch and drinking water

Field Protocol

A. Upon arrival at site, scout out/hike the length of entire creek within meadow. Choose and measure the most representative 75 meters for the sampling reach.

B. Collect data for each protocol components:

1. **Visual Encounter Survey**
    a. As measuring tape is being placed, whole team spreads out along both banks, along riparian corridor and zig-zagging general site area 10 meters from bank.
    b. Search for reptiles, amphibians and egg masses, capturing in net if possible, recording species and size. Make estimate if necessary. Record start and finish time in order to provide catch per unit effort.

2. **Conduct chemical/physical sampling**
    a. Record GPS coordinates at upper and lower reaches in UTM and NAD 83.
    b. Take digital photos facing both up and downstream and left and right banks at mid-reach. Take photos of any impacts observed. Record photo numbers and locations.
    c. Record beginning air and water temperatures, allowing meters to equilibrate to ambient conditions.
    d. Take pH and Conductivity readings, conduct Dissolved Oxygen test below lowest riffle with representative flow. Record on data sheet. Grab a turbidity sample in yogurt jug and estimate water clarity/turbidity based on a 1-5 scale, 1 being clear water, 3 being cloudy (>4" visibility) and 5 being murky (4" visibility).

3. **Transects/Geomorphology**
    a. Measure the stream width at 15 evenly spaced intervals along the reach. At each transect, measure the depth using the handle of the kick net at 25%, 50%, 75% across the wetted perimeter.
    b. Determine bankfull levels at three locations, measuring width and height above water surface to determine amount of total water that moves through stream year round.
    c. Find one transect with fairly even flow across the stream and measure it's width; divide the width by ten, taking ten velocity measurements and depths across the channel. If a flow meter is not available, use a timed orange float over a known distance, replicate it five times, take the average to calculate stream flow.
    d. Walk the length of the reach and record number of meters of pools, glides, runs and riffles. Estimate % clay, sand, gravel, cobble, boulder, bedrock and silt cover.

4. **Macroinvertebrates**
   a. Using a modified version of the California Bioassessment Monitoring Protocol, CBMP, level II, sample in three riffles within the reach. Using D shaped Kick net, sample in three riffles, 1 square foot transect each(9 sq ft total), creating one composite sample.
   b. Sort insects in water on trays in the shade so bugs stay alive; swimming and crawling behaviors assist in IDing.
   c. ID to Family , or Order if family not known; tally # of Families in Orders; ID 100 bugs, estimate the rest; note % substrate on data sheet.
   d. Return bugs to creek as soon as possible.
   e. If necessary, collect un-ID'd bugs in jars with ethanol, labeled with site #, date and names of samplers to ID in lab under microscope.

5. **Rapid Bioassessment**
   a. Use the modified CMBP Habitat Bioassessment metric for meadows, 10 metrics are each scored 0-20 to make a combined score of 200. A team of at least three people should achieve consensus on each metric. This team should be the same people for all meadows to be assessed for the season.

6. **Vegetation**
   a. Focus on plant functionality (how each species performs a given ecological function) of the species present, and meadow type in order to record general meadow health. Record and photo document impacts observed.
   b. In a team of two, walk along the stream banks within the reach using a 'green line' protocol. Divide the surrounding meadow area into 25 meter transects running parallel to the stream. Record all species of vegetation observed. If species is not known, write down type of vegetation. Estimate percent cover for each of the species within reach. (% Cover does not need to add to 100% as we assume multiple canopies). .
   c. Record percent rock, bare ground.
   d. Record grazing height if appropriate.
   e. Dig auger hole to determine moisture regime (saturation/soil type/ mottling), the depth at which frequency of roots is less than 100 per decimeter. Analyze soil for saturation….., has water table dropped or hydrologic function has been lost?
   f. Record meadow type: hydric, mesic, or xeric.
   g. Look for signs of water retention and how long it takes water to move down meadow
   h. Plant functional ratings
   i. Rooting Frequency, how frequent (presence/absence) certain species is rooted in a specific spatial area.

C. Before leaving Field Site
   1. Make sure that data sheets are complete
   2. Meet as an entire team to discuss positives and negatives of the day

3. Discuss the overall health of this specific meadow, note comparisons with other meadows, based on specific criteria. Is restoration recommended?
4. Note any methods in need of improvement and share appreciation for the team.
5. Discuss plans for the next meadow assessment.

Completing Health Assessment in the Office

A. Quality Assurance of data by review of sheets
B. Entering Data
C. Guidelines and Suggestions for an Assessment Report

Literature Cited

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