6 Information Management

Introduction

Prior to beginning a springs stewardship project, it is important to compile, organize, and archive available data and plan for baseline and monitoring information management. The springs information management system and its metadata should be easy to access, secure to protect sensitive data, and support reporting and analyses. Few such information management systems presently exist for springs ecosystem data. Often, the limited available information is disorganized and largely unavailable to land managers, researchers, and stewards.

SSI developed Springs Online—a secure, user-friendly, online database where users can easily enter, archive, and retrieve springs information (https://springsdata.org/; Fig. 6–1). This database is relational, providing the ability to contain many surveys for each site and to analyze diverse variables and trends over time. It is broadly framed to accommodate a wide array of variables, schemas, and information types.

SSI developed Springs Online based on the assumption that springs steward(s) will want, use, and maintain a long-term information management program for their springs. In the case of large landscape management units (e.g., National Parks, National Forests, and Tribal reservations),

Fig. 6–1. Springs Online at http://springsdata.org/ is a secure database designed to enter, analyze, and report on springs data. Users must create an account, and a sophisticated permissions structure protects proprietary or sensitive information.

such an information management system needs to relate to the steward's goals as well as their geographic information system (GIS) program. Springs stewards are likely to need data archival, site photography, appropriate specimen curation capacity, and clearly defined metadata and standardized reporting. Springs Online fills these information needs, providing a secure, user-friendly interface for data entry and analysis. For example, the fields in the database have dropdown boxes and are aligned with the field sheets to ease the data entry process.

This technology is freely available to all springs stewards who sign up for an account. With interest, examination of the database user manual, or online or workshop training, virtually any English-speaking individual can use this electronic portal to compile, archive, monitor, and report on springs. Easy retrieval of information from the Springs Online database provides long-term evaluation of change and response to management activities. Each night all data are exported into a geodatabase that SSI can package and deliver to land managers. The database user manual is available at **https://springstewardshipinstitute.org/database-manual-1**.

Information security is a high priority when archiving sensitive information gathered from Tribal lands, private property, and historical sites rich in artifacts in National Parks and Forests. Springs Online offers secure archival of such information. Administrators can assign permissions specific to a steward, land unit, or project.

Springs Data Management

Early Planning

One of the earliest steps in any springs stewardship program should be to create a data management plan. Unfortunately, this step is too often neglected until after field data are collected, inevitably leading to inefficiencies and sometimes even to failure in producing a report or analyzing the results.

Stewards should plan and implement a data management system early in a project in order to properly organize and archive the background information that they gather about each spring. Compilation and review of legacy data leads to better understanding of what information is already available. Without such a system, these background data can easily become disorganized and lost into an individual staff member's files, creating additional work in the data collection and reporting phases, and perhaps even resulting in permanent loss of data when that individual moves on.

The other major reason that data management should be considered early in project planning is that data entry, quality control, analysis, and reporting require a substantial amount of time and labor, and thus should not be neglected in the project budget. The Level 2 springs inventory protocol produces a somewhat complex dataset with data from 12 major categories to enter, quality control, analyze, summarize, and properly archive. Without a well-designed data management system, this series of tasks will be difficult to implement efficiently.

A well-designed data management system will, at a minimum, be customized to the field survey protocol, and should be designed to facilitate data quality assurance and quality control, analysis, and reporting. It will also keep data organized and properly archived for future use. While we recommend using Springs Online to maintain your springs inventory data, any choice of data management system will need to fulfill the requirements outlined above.

Springs Online

The several categories of data collected using the Level 2 inventory protocol are ecologically interrelated. For example, water quality is linked to springs flow rate, geology, geomorphology, soils, flora, and fauna. As a relational database, Springs Online provides a framework to address this ecological complexity and facilitates analyzing relationships among biological, physical, and cultural variables over space and time.

Because the Springs Online database structure and interface are customized for SSI and other agency spring inventory protocols, the data entry process is streamlined, with forms and data fields arranged to match the field sheets. The system is populated with drop-down fields that facilitate data entry, assure consistency, and minimize error. Buttons and tabs allow the operator to easily

move between forms.

Springs Online includes the capacity to export summary reports of data, facilitating quality control, data analysis, and reporting (described in more detail below).

Perhaps the most unique and valuable aspect of Springs Online is the fact that it provides long term archival of data for multiple users with flexible built-in security. This powerful combination of traits promotes collaboration among springs stewards and facilitates trend analysis.

Springs Online's capacity is broad enough to include establishing baseline datasets, informing the assessment process, guiding monitoring, evaluating stewardship efforts, tracking restoration actions, and monitoring changes influenced by aquifer depletion, climate change, and other factors for individual springs, or for many springs across a landscape. The long-term value of such collaborative information management systems is the opportunity to share data with other springs ecosystem managers across political boundaries.

Stewards implementing a springs stewardship program should consider using Springs Online to manage their background and field data. This purpose-designed database is freely available online; users need only create an account and request appropriate permissions.

Springs Online Data Entry

Because we are constantly improving Springs Online, we have chosen not to include a how-to guide for data entry in this workbook. It would require revision too often. Please visit the Springs Online database user manual, at https://springstewardshipinstitute.org/database-manual-1 for data entry instruction. Also, throughout Springs Online the question mark icons serve as convenient links to relevant sections of the manual (Fig. 6–2). Also please visit the SSI homepage to watch recorded webinars about recent developments in Springs Online, at https://springstewardshipinstitute.org/webinars.

Fig. 6–2. The red arrow indicates the question mark icon on the site description form in Springs Online. Users who click on the question mark icon are redirected to the relevant section of the Springs Online Database User Manual for detailed data entry instruction. These question mark icons appear on each data form in Springs Online.

Quality Control of Data

Quality control analyses of data entered into any data management system is an important step that should not be neglected. Data quality control is the responsibility of the crew supervisor or other designated individual, and should be conducted using standard methods. Data entry errors and data checking should be documented and corrected.

Project-level data can be downloaded from Springs Online in tabular (.csv). These tabular downloads, described in more detail in the next section, are helpful for project-level quality control.

Reporting

Overview

Stewards who choose to enter their springs inventory data into Springs Online can automatically generate several different types of reports, as described below. An in-depth, frequently updated manual on how to manage information in Springs Online is available at the SSI website (https://springstewardshipinstitute.org/database-manual-1).

Individual Site Descriptions

Users of the Springs Online database can generate site-specific reports in Microsoft Word once the survey data have been entered. These survey summary reports include: the spring location with all georeferencing and geographic data, the names of the survey team members, the date and start and end time for the survey; a physical description detailing the spring type, its source, springs microhabitats, geomorphic diversity, available solar radiation, emergent environment, and flow force mechanism; survey notes that include the condition of the site; flora data that include the species list, vegetation cover types and percent cover along with species nativity and wetland indicator status; fauna data including invertebrate and vertebrate taxa lists; assessment information from the SEAP defining the risk and condition of site-specific biology, geomorphology, aquifer functionality and water quality, habitat, and human influences; management recommendations; representative and additional photos of the springs ecosystem; flow measurements, water quality data, and sketchmap. A simple export into Microsoft Word format vastly simplifies report generation and allows project managers flexibility in editing.

Project Reporting

Springs Online users can also download a summary report describing all the springs in a project (Fig. 6–3). These reports are a compilation of individual site descriptions and are exported in Microsoft Word format. Users can also download project data in tabular (.csv) format, including a table showing all of springs in the project with the geographic coordinate, elevation, and springs type of each; other tables that report spring flow rates, water quality, and SEAP assessment scores; and crosstabs of plant, vertebrate and invertebrate species. These data exports can be conveniently used for data quality control efforts and additional analysis.

Trend Detection

Trend detection is a valuable and crucial part of monitoring. Data to inform trend analysis can be readily exported for any site or project in Springs Online, in the form of reports in Microsoft Word format and data exports in tabular (.csv) format. Many of the variables used in trend detection at springs ecosystems are influenced by seasonality. Therefore, caution is warranted when attempting to draw conclusions based on comparison among a small number of repeated site visits. See the Level 3 Protocol for a discussion on designing springs monitoring plans.

Landscape Analysis

Springs Online's capacity to export project-wide tabular data is a convenient first step toward synthesizing landscape-scale analyses of springs data. A landscape analysis should summarize all of the individual springs data from a project into a single document detailing all inventories undertaken. The result of this analysis might include the total number of springs inventoried, the number of reported springs locations where no spring was found, and the average and median area of springs surveyed. From the total number of springs reported on a landscape and the median area of surveyed springs, it is possi-

ble to estimate how much springs habitat exists within a landscape.

Further results of a landscape analysis might include summaries of water quality and flow data, with explanation of general trends of observed during surveys. A vegetation analysis might include reports of plant species richness and relative cover of native vs. nonnative species, and relative cover by functional group. These analyses can be completed for each spring individually and for the project as a whole. Similar analyses, examining species diversity and frequency, can be completed for vertebrate and invertebrate fauna.

SEAP results conclude this analysis with the risk and condition scores for each springs plotted in a graph to represent the springs that warrant the most immediate management attention. SEAP analysis techniques are described in detail in Stevens et al. 2016. Managers can use this analysis to apply limited resources to those springs that have the greatest potential for improvement.

Fig. 6–3. In Springs Online, the "Reports" tab allows for site or survey-specific reporting.