Environmental Data Management Best Practices

Managing Traditional Ecological Knowledge Data

This subtopic sheet explores concepts surrounding the effective management of traditional ecological knowledge (TEK) data for use in an environmental context. Key themes include general data types and associated challenges, required metadata, the importance of contextual information, and ethical treatment of TEK.

Overview

Traditional ecological knowledge (TEK) is unique, place-based, and a product of long-held relationships with land, neighborhood, or community. Thus, TEK data are sensitive and require agencies to treat the knowledge contributors with respect and a sense of reciprocity. LEK is similarly place-based and a product of social relationships. These two types of knowledge are not the same, but should be treated with similar ethical considerations. These data have special data and management considerations. We refer to both traditional and local knowledge in this subtopic sheet when referring to TEK.

Purpose and Significance

TEK is a place-based, contextually dependent knowledge that is held and owned by First Nations and tribal communities, local residents, and other resource users. This knowledge may seem difficult to collect because standard environmental management relies on well-known stakeholders who may already be connected to the environmental process. Standard environmental practices may leave out communities and traditional knowledge holders who may have a different relationship with the environmental resource to be managed. However, these communities may be able to share phenology, hydrology, or other natural history knowledge important to projects or management actions. As a result, if not intentionally invited and included, these voices may be lost or not well understood because they may use different language and concepts and may describe personal relationships and experiences that may or may not translate well into modern environmental management.

TEK should be treated similarly to other environmental data, but it requires stronger ethical considerations. Data to be managed may include stories, photos, archive documents, notes, and agendas from meetings, or collected comments from directed questions. It will be necessary to create a data management plan to track how and when data are collected (see Acquiring TEK Data subtopic sheet), how they will be managed and shared, and how they will be used (see Using and Consuming TEK Data subtopic sheet). Data may be stored similarly to other types of data on protected agency servers and agency protocols for data collection may be followed. Ethical considerations should include protecting privacy and confidentiality, removing personally identifiable information when necessary, and maintaining contact with the knowledge contributor, community group, and institutional review board (IRB).

Data interpretation may require consultation with social scientists or other experts in qualitative analysis and Indigenous

knowledge. Data may not have meaning or relate to the problem to be solved or to the regulatory process until they have been analyzed. Identification and characterization of themes and meanings to different audiences will facilitate conversation (Fond du Lac Band of Lake Superior Chippewa 2018; Williams et al. 2018)

Stakeholders and Communications

An important point when managing TEK is taking an active engagement and communication role with the local rightsholders and stakeholders. Although this active engagement and communication is often more important and vigorous before and during TEK acquisition, it must be maintained through all phases and aspects of TEK management.

- **Who are the stakeholders?** Stakeholders in the context of traditional knowledge are the long-term residents or those who have a relationship with a place. They have a sense of kinship or ownership with a place. For them, being referred to as a "stakeholder" may be considered offensive. Those who contribute traditional knowledge are also experts.
- **Who are the rightsholders?** A rightsholder is a stakeholder who, in addition to having a relationship with a place, also has a legal right or direct ownership of a place. As an example, an Indigenous community may have a treaty right to a place or a famer/rancher may have ownership of his/her land. This is an important point as there may need to be a different approach/strategy when engaging and communicating with a stakeholder and a stakeholder that is also a rightsholder.
- **Communication timelines and reporting back.** Bidirectional communication should be built into the project and data management plans. Tribal nations and other knowledge holders may have expectations for how their knowledge is being used in an official process. Ongoing consultation will build trust. Communication should start early and be maintained throughout the effort.

Confidentiality and Sensitivity

For many traditional knowledge holders, there is a high expectation of ethical treatment of their knowledge. Indigenous communities see knowledge and resources as communal property; thus, they often have an IRB or ethics office to review research and data sets to protect the tribal community.

Even if there is no IRB, sensitive communities or resource-based communities may have similar expectations without a formal body to manage data use and representation. Possible management strategies include regular check-in meetings, creating ways to share data, community advisory bodies, and user agreements. All knowledge contributed by any community should be treated with confidentiality and respect the privacy of the contributor. Methods should also be outlined in data management plans.

At times, there may be a need for translation of meaning across communities and agencies. Conceptual models, such as the Neighborhood Model (Williams et al. 2018), can be used to help interpret the meanings of community knowledge contributions to relate to agency decisions. This is important because a resource may have deep, personal significance to community members, while agencies are often responding to mandates, budgets, and other political pressures. Both valuations of the resource are valid and may require interpretation to uncover.

Data and Information Types

TEK data are context-dependent and may be situational. These conditions may present a challenge to "standard" methods to categorize data hierarchically. Thus, by employing standard methods of data management, we may fall short of capturing the context necessary for appropriate integration and use. We have attempted to document the spectrum of data and information types that are common across TEK in an environmental context, and to provide a framework for capturing and managing this data to use it successfully and appropriately. While we have made every effort to review existing TEK data management literature and polled practitioners in this area, we acknowledge that this list is incomplete.

The main categories of TEK data addressed in this subtopic sheet include:

- **direct and verifiable measurements.** Includes observations, physical sample data, historical or contemporary geospatial information, and documented records. Examples of this category include state and tribal archives,

meteorological data, surveys, anthropological or archaeological studies, environmental studies, and academic theses. This category overlaps with, and may contain, scientific environmental data sources that are related to TEK.
- **literature, including audio, visual, or written materials.** Written or other media material that describes, interprets, or documents TEK outside of the scientific literature. For example, a video documentary cataloguing TEK, or interviews with TEK sources.
- **stories, including audio, visual, or written communications.** Includes material supplied by or attributed to direct TEK sources and may include personal journals, meetings or personal communications, chat logs or web contents, or audio clips.
- **imagery/photography/media.** Visual documentation of TEK source information, including acquired or described photography, video, or other imagery.
- **historical/time-bound, longitudinal reference.** Timelines, event documentation, or other data related to specific historical periods. This category of data overlaps with all above categories, but remains distinct to allow for TEK that is event-driven.

A summary of these data types and their respective examples, data management considerations, and challenges is available in Table 1.

Key themes that should be considered in managing TEK data are described below:

- TEK data are focused on multigenerational data with periods spanning hundreds of years. Verification of timelines is therefore problematic and gaps in information over time are to be expected.
- Ceremonies can be tied to weather events or seasonal changes. They can include traditional observations of climate and cultural cycles.
- A large amount of TEK is embedded in tribal stories, whether documented or archived or passed through oral tradition.
- Respect for the storyteller is important—sharing the story is a voluntary act on the part of the storyteller.
- Be aware that the data source may not share information the same way with a researcher as they would with others.
- Data ownership and lineage are key data management considerations for TEK. Co-production of data and clarity on ownership and responsible use is required, and transparency around intended use of the data is critical for creating and sustaining trust with the TEK community. Documenting lineage, where possible, is necessary for understanding and acknowledging temporal gaps and evolutions within and between data sets, and for connecting timelines relating to different kinds of events—for example, seasonal versus generational.

Metadata

Metadata are particularly important for managing TEK. Environmental data sets typically contain information on source, intended use, ownership, use restrictions, known quality, and other limitations as accessory documentation via a data management plan, field/laboratory report, or other document that accompanies the data as they flow from creator to user. For TEK, that accessory documentation may need to be created or co-created by the acquirer and the data source (for example, tribal contact or community member), and may carry additional restrictions relating to privacy and appropriate use. At a minimum, the following metadata categories are recommended, though this is by no means an exhaustive list:

- data source name and affiliation
- data source contact
- data type (for example, media, photograph, observation, oral tradition, personal communication)
- geographical context (see below)
- cultural context (see below)
- temporal context
- related data source
- data lineage (that is, data evolution or movement from original source, through acquisition, to current state)
- data ownership

Table 1. TEK data types, examples, and management considerations

Data Type	Verifiable Measurements	Published Literature	Personal or Collective Stories	Imagery	Historical Timelines and Events
Description	Direct and verifiable measurements, including observations, physical sample data, historical or contemporary geospatial information, and documented records	Written or other published media material that describes, interprets, or documents TEK outside of the scientific literature; for example, a video documentary cataloguing TEK, or interviews with TEK sources	Material supplied by or attributed to direct TEK sources, including personal journals, meetings or personal communications, chat logs or web contents, or audio clips	Visual documentation of direct TEK source information, including acquired or described photography, video, or other imagery	Timelines, event documentation, or other data related to specific historical periods or events
Examples	State and tribal archives, weather records, environmental studies, academic theses and journal articles, survey data	Biographies, documentaries, community archives and newspapers, agricultural practices, treaties	Personal stories, ceremonies, personal journals, social media, meeting transcripts or audio clips, oral history, oral traditions	Participatory mapping, photographs, personal videos, historical maps and diagrams, aerial photography	Land use/land cover change, climate/biota change observations, oral history, historical aerial photography
Management Considerations	Traditional database management for discrete data, spreadsheets, GIS/spatial management	Annotated bibliography, document management, source categorization, keyword tagging	Document management, bibliography, keyword tagging, audio transcripts	Volume storage, image classification and tagging, federal repository, geotags, geospatial management	Date tagging, geotagging, frequency, seasonality, change documentation, time period/transition
Challenges	Precision, applicability, language and translations, regulation/policy variation across communities and governing bodies, combining qualitative with quantitative, establishing trust and enforcing appropriate use boundaries, confidentiality	Validity, data lineage, source determination and backup, privacy, definition and accounting for “unknown” source, formats, legal history/interpretation of treaties, validity/acceptance, availability	Retaining “meaning” during translation, knowledge/ownership/privacy issues, definition and accounting for “unknown” source, appropriate framework for sharing, attribution/context/reproduction, privacy and ownership, respect for storyteller, distinguishing history from mythology	Privacy, volume, automated interpretation (privacy and protection concerns with not having consent for facial recognition), metadata, including Federal Geographic Data Committee (FGDC) and TEK recommended	Temporal measures may be differential, timeline verification, gaps in information intensity/availability over time, ambiguous time periods, multigenerational data—hundreds of years

- data access restrictions
- data use restrictions
- obligations (see below)

Metadata requirements relating to TEK should be outlined in the data management plan as distinct or in addition to any metadata requirements relating to other data types.

Geographic Context

Geographic context is an important consideration for TEK, which is often place-specific because places are a product of experiences and socially constructed meanings (Cresswell 2004; Tuan 1975). Geographic context may range from a point to a region, depending on the problem to be solved. Geographic context is also the environment type (that is, coastal area, mountainous, rangeland, urban, agricultural, etc.) There is also an agency context that may be based on geography. For example, agencies often work in a geography, but may work at different scales (for example, regional or state-wide) or on mission-driven activities. Communities, on the other hand, are often rooted in a specific place and their environmental knowledge may have been developed over time and experience. As a result, agencies may need to develop close collaborations with traditional knowledge holders to develop an understanding of the meaning of a place or different perceptions of geographic context.

Cultural Context

One of the challenges to understanding and applying traditional and local knowledge for regulatory agencies is that traditional and local knowledge is based on relationships and is deeply context-dependent. Unlike all other types of data that environmental practitioners acquire, analyze, and use, traditional knowledge has the added dimension of cultural or local importance. Similar to traditional knowledge being passed down via multiple generations, the associated cultural attachment knowledge is also passed down and may not be understood or appreciated outside of the tribal or local community. This is an important concept that practitioners should be aware of in all phases of data management: planning, acquisition, processing, evaluation, sharing, and retention.

Some examples of the cultural context or association embedded within traditional knowledge include, but are not limited to:

- burial or sacred areas
- plants and animals used for ceremonial use (for example, plants and eagle feathers used during Indigenous smudging ceremonies)
- songs or story telling as a mechanism for traditional knowledge communication
- art as a mechanism for traditional knowledge retention and communications
- social core values and beliefs as a mechanism for ecological and land use evaluation
- areas, plants, or animals that have spiritual importance

Although acquisition of the underlying cultural context associated with traditional knowledge may at first be difficult to discern or not deemed necessary by practitioners, it is critical to understand, as it provides a holistic understanding of the different values (that is, use, non-use, traditional, community, and agency) of the environmental resources to be managed. This greater understanding allows for a more accurate and robust mechanism for data translation, quality control, interpretation, and use by the environmental practitioner.