

Data Care and Its Politics: Designing for Local Collective Data Management as a Neglected Thing

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ABSTRACT

In this paper, we think with Puig de la Bellacasa's 'matters of care' about how to support data care and its politics. We use the notion to reflect on participatory design activities in two recent case studies of local collective data management in ecological research. We ask "How to design for data care?" and "How to account for the politics of data care in design?" Articulation of data care together with ethically and politically significant data issues in design, reveals in these cases the invisible labors of care by local data advocates and a 'partnering designer'. With digital data work in the sciences increasing and data infrastructures for research under development at a variety of large scales, the local level is often considered merely a recipient of services rather than an active participant in design of data practices and infrastructures. We identify local collective data management as a 'neglected thing' in infrastructure planning and speculate on how things could be different in the data landscape.

CCS CONCEPTS

• **Human-centered computing~Participatory design**

KEYWORDS

Matters of care, politics, data care, local collective data management, information management, infrastructuring, information infrastructure, Participatory Design, Science and Technology Studies, partnering designer.

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1 INTRODUCTION

We investigate data work practices and design activities using Puig de la Bellacasa's 'matters of care' [1] in our study of local collective data management in ecology. Scientists have increasingly turned to working collaboratively on complex subsystems of nature and the coupling of these 'natural' systems with human built systems. As data are a foundational element of scientific research, such efforts often entail working with assemblages of heterogeneous data and a variety of data structures. A recent mandate from the U.S. Office of Science and Technology Program (OSTP) [2], similar to data policy developments elsewhere, e.g. EOSC [3], aims to ensure 'no researcher is left behind' in collective data practices. These policies aim to establish a new norm: data sharing. Government funded research proposals must now include a data management plan that describes the data as well as how they will be preserved and made accessible for sharing. Though some large-scale cyberinfrastructures have been developed, the infrastructure to support data sharing for researchers generating data at all levels, including individual efforts and local communities, is not yet in place. As a result, data management plans are often incomplete or inaccurate. Planning has stirred discussions about data work that in turn informs the design and development of data infrastructures.

Data sharing policies are changing today's data arrangements in dramatic ways. Activities are fueled by continuing development of digital communications and technological capabilities. With digital data work increasing and 'big data' systems for research being developed at organization-wide, national, and global scales [4-9], the local level is often considered merely the recipient of services rather than an active participant in design of collective data practices, data systems, and community infrastructure.

At the local level, the work of 'design' associated with data management often is not recognized. Rather it is entwined with

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a variety of services associated with tending and maintaining data, work that includes support for researchers' data needs [10]. Researchers who traditionally have carried out their own or their laboratory's data management, may see local data management as 'more of the same', that is, routine procedures supporting data activities instead of recognizing it as a complex and extended design-oriented activity that we call 'local collective data management' [11]. Local collective data management facilitates assembly of data generated by individual researchers with a shared interest and contributes to the well-being of science by developing digital capabilities that support local knowledge work in addition to producing data for unanticipated reuse.

Data management as a proactive role has not been of great interest in Participatory Design (PD) though identified as an element of infrastructuring [12]. More generally, data issues have been rarely investigated in PD, with a few exceptions, e.g. [13-15]. A special issue on 'Data' for Science presented issues associated with "the increasingly huge influx of research data" [16, p. 692]. While managing data is clearly part of cyber/research infrastructure development, these fields are driven more by technical and larger-scale interests in public data access, preservation, and reuse than local data care and management and use in the field or in the laboratory [17]. Socio-technical research on the roles of data in science and approaches to data sharing provides descriptions of general data issues in science [18-20]. In science and technology studies of infrastructures, e.g. [21,22], typically more inclined to critical analyses, the politics of data have been highlighted, e.g. [23-25], but data management has rarely been addressed. Local data and its management is the kind of 'boring', taken-for-granted support work described by Star [26] and labeled a 'neglected thing' by Puig de la Bellacasa [1].

In ecology, previous work on everyday data management practices at site-based communities includes discussions relating to data management and infrastructuring over extended time periods [10,27-30], collaboration in data care and design [31,32], and ethics of care in the work of data managers [33]. In this paper, we identify with the concern previously presented in PD as "lack of care for our creations, including our technology, our society, and ... nature" [34, p. 151]. Aligned with Light and Akama's recent work [35], we choose Puig de la Bellacasa's thinking on 'matters of care' [1] as a companion in turning to the ethos and politics of data care. By exploring the engagement of an outside PD researcher, a 'partnering designer', with two ecological research communities engaged in local collective data management, we ask, "How to design for data care?" and "How to account for the politics of data care in design?"

Ecology as a field-based science conducts research outdoors in the natural environment where phenomena are observed and data generated 'in-situ' rather than in a laboratory where conditions are more controlled [36]. When sampling is carried out in a coordinated manner by a group of field scientists at a well-defined location that may include an on-site field station, they often form a 'community of practice' (community for short in the following) [37], defined as having a shared knowledge base relating to the ecological site, developed through both

experience and study of various aspects of the same biome. In a community of scientists studying the same site and interested in coordinating sampling, analysis and/or data access, aggregation of data serves as an important integrative and learning process.

In the first of two cases studied, EcoPrairie has an embedded information manager, a local designer mediating between local scientists as data generators and the assembly of scientific data in data systems. When the community's research funding is terminated after more than three decades, the local information manager invites an outside partnering designer to collaborate. In the second case, EcoRiver data management efforts are launched by researchers who mediate between data holdings of individual scientists and the concept of collective data management. A partnering designer engages with them to address differences in imagining data work and the realities of collective data management as a complex design issue.

The first author of this paper, the partnering designer in the cases studied, with a background in practical data work, information sciences, and PD, conducted the fieldwork and carried out the analysis of interviews and case documents. The pronoun 'I', used below in describing community interactions, refers to this work. The second author, with a background in ethnographic research in data management and infrastructure work in ecological sciences as well as in PD, brought forward the notion of 'matters of care' to think with, analyze and articulate the care qualities and politics in data work.

The next section introduces 'matters of care' for scientific data, followed by a presentation of methods in Section 3. In Section 4 we describe the two case studies and think with 'matters of care' about designing for local data management. Section 5 discusses the partnering designer role in four kinds of nurturing 'doings' and 'interventions' as well as in the politics of designing for local collective data management as a 'neglected thing'. Final remarks underscore the significance of 'thinking with care'.

2 SCIENTIFIC DATA 'MATTERS OF CARE'

Puig de la Bellacasa [38, p. 4] defines an act of care as "the affective and ethical dispositions involved in concern, worry, and taking responsibility for other's well-being." An earlier turn from considering 'matters of fact' to considering 'matters of concern' created a new way of thinking about technoscience work [39]. In recognizing the many possible configurations for technoscience systems, Latour [40,41] brought attention to both 'matters of concern' and knowledge politics as critical issues which have informed design research, e.g. [42-44]. Puig de la Bellacasa [1] moves from 'matters of concern' to 'matters of care', pointing out that care "adds a strong sense of attachment and commitment to something" [1, p. 89-90]. In a nutshell, she says: "to care signifies: an affective state, a material vital doing, and an ethico-political obligation" [1, p. 90]. According to her, care "has stronger affective and ethical connotations" than 'matters of concern' [1, p. 89].

We understand that "caring as something we do extends a vision of care as an ethically and politically charged *practice*" and

“material doing” [1, p. 90]. To her, there is hands-on agency to care that involves “doing and intervening” [1, p. 89] in the sociomaterial configurations of the world. In addition, “care connotes attention and worry for those who can be harmed ... but whose voices are less valued, as are their concerns and need for care” [1, p. 92]. The notion of matters of care encourages critical standpoints and sensitivities of care that engage “with persistent forms of exclusion, power and domination in science and technology” [1, p. 91]. Puig de la Bellacasa proposes “cultivating a speculative commitment to contribute to liveable worlds” [1, p. 100]. In the context of scientific data, this includes thinking about the responsibility of choices made by data workers about scientific data and by all those designing the dynamic digital systems shaping the world within which we live.

2.1 Care for Scientific Data

Puig de la Bellacasa presents ‘matters of care’ as “a proposition to think with” [1, p. 100]. Rather than offering a method to expose what ‘matters of fact’ are, it suggests studying and participating with them with commitment to care. This involves, for instance, generating more caring relations, participating in their ‘becomings’, and speculating how things could be different if they generated care. Therefore, caring is “more about a transformative ethos than an ethical application” [1, p. 100]. In each situation, we need to ask ‘how to care’. According to Puig de la Bellacasa, “generating care means counting in participants and issues who have not managed or are not likely to succeed in articulating their concerns, or whose modes of articulation indicate a politics that is ‘imperceptible’ within prevalent ways of understanding” [1, p. 94-95].

In an era of data sharing, care involves critical commitments to designing for and learning from the scientific use of data in local communities as well as for the preservation and curation of data for reuse by multiple audiences located remote from the data origin. Choices made about the data management processes impact scientific work. Given the number of kinds of data contexts, the concept of care also carries with it a responsibility for awareness of diversity and the need to consider how decisions fit within and impact the larger data landscape.

2.2 The Politics of Data Work

While the notion of ‘matters of concern’ speaks to developing awareness of the multiple issues associated with data work – sharing of data, development of data centers, and responsiveness to changing practices, the notion of DingPolitik [39] brings attention to how politics develops around a ‘thing’. It underscores how a thing exists within an ethico-political context, that is, a landscape full of relationships with living and non-living entities. The need for unceasing concern is captured in the concept of ‘thinkpolitics’ proposed by Puig de la Bellacasa [1]. That is, data work and its infrastructures entail not only concerns about technical components such as hardware, software, and data delivery, but also include the politics of how data work arrangements, data expertise, and digital capacity are developed and distributed. Given recent attention to FAIR

(findable, accessible, interoperable, re-useable) data principles, data work and the use of data in scientific knowledge-making within community data arenas are of concern. With the development of digital capabilities ‘elsewhere’, external to local data arenas, will local collective data management be marginalized? Will data care move out of local laboratories and the hands of site-based science to remote centers, thereby increasing the risk that it become a ‘neglected thing’?

In considering the ‘thinkpolitics’ associated with large-scale centers of data work and infrastructure design, we are prompted to consider not only what an external center enables but also what it inhibits. Does a center and its promises delay or preclude other efforts in tune with different stakeholders or local needs? Does it sequester development of digital expertise so some regions do not have the opportunity to develop digital expertise by doing? Does it streamline data production to the detriment of cross-checks on data quality or of meanders in scientific inquiry? There is a continuing need to ‘thinkpolitics’ and to foster caring relations as we structure digital environments that support not just the rapid progress of digital capabilities in centers but their availability within other scientific data work arenas across societies at large.

3 METHODS

Empirical research took a longitudinal approach and integrated ethnography with PD, with a special focus on sensitivity to participant views and opportunities for engagement [45,46].

3.1 Ethnographic Work

Participant observation and interviews at strategic intervals were carried out adapting to the rhythms of activity at each site. Research unfolded over a 3-year period with the EcoPrairie case and over a 4-year period with the EcoRiver case. I began analysis while at the project location and continued afterwards with coding, memoing, and situational analysis [47] for theme building. A total of 43 interviews were conducted, 15 of which were with community data advocates. In addition, I participated in two working groups and 30 group sessions. Work at EcoPrairie included nine months of quasi weekly visits, two extended visits, and regular virtual interactions when I was not residing near the site. For EcoRiver, a nearby site, 1-3 day visits were scheduled throughout the year in concert with project activities. Prolonged engagement enabled triangulation, thick description, and member checking.

Each case began with an invitation from a community member. Jensen [48] describes partnering with participants as ‘intervention by invitation’. My invitations were issued by a data advocate, that is, a key informant that became a ‘data ally’. Following Beaulieu’s ‘infrastructural allies’ [49], we use ‘data ally’ to refer to informants able to identify and consider various scopes of work involved in data care and infrastructuring. Joint activities create a venue for appreciation of existing practices and situations as well as for discussion of ‘matters of concern’ [40] and ‘matters of care’ [1]. Institutional support for data work

existed in both cases so data allies were available to work collaboratively and speak freely with an invited partner.

3.2 Partnering in Design

I gave priority to creating an understanding of a site's various dimensions of data work. We dedicated time to considering the community's position within the larger data landscape. Everyday interactions brought familiarity with the community including its context and history drawn out through the collaborative construction of timelines. As partnering designer, I played an active role at the site. Balancing research and designer roles was a constant effort. Since my standpoint was not fixed and I appreciated the complexity of local data work, I left final decision-making about data work to data allies. Choices drew on their extensive knowledge of the community as well as their tacit understanding of how to operationalize design work.

A data ally and an external partnering designer constitute a small data team with ideas that are developed locally. While a partnering designer can only partially understand a community, a data ally typically has deep knowledge of their community's entangled work arrangements and a keen awareness of the timeliness of activities so can serve as a translator of the data team's findings and a disseminator of the team's negotiated insights. Developing ideas locally with a partnering designer supports an ally's desire to improve care for community data.

3.3 Thinking with 'Matters of Care'

Thinking with 'matters of care' has given us more than just an analytic lens to revisit the case studies. It has given us a new opening for onto-ethico-political questioning and deliberating. We have taken the opportunity to move on from our previous focus on 'matters of concern' with sociotechnical practices and assemblages of data work. Thinking with 'matters of care' has given us a chance to create a legitimate standpoint from which to speak. We explore how to imagine and use the vocabulary of caring for this data-related 'thing' of local collective data management that involves both things and people connected in practice. We see how care resides with data allies as do worries about the importance of data quality in scientific knowledge making. They face the dominant discourses and models of large-scale centers that promise support for and automation of data work while creating a gap between local and centralized efforts that requires continuing interaction. The activities of a 'partnering designer' bring support for local participants addressing requirements for standardization and harmonization of data that are part and parcel of large-scale data assembly. These requirements facilitate data sharing and 'Big Data' analytics but they also impact local data work.

The 'thing' of local collective data management is in practice related in multiple ways to a 'a web of things' that constitute data infrastructures in which the local is embedded. With this in mind, we encounter the politics of the distribution of its parts, including what parts can reside and be tended locally. A 'partnering designer' may empower data allies in finding ways to voice their worries in ways other than those that are

dismissed as 'whining' from the margins. The combination of data allies and a partnering designer can raise awareness of significant scientific issues at stake in taking account of local data concerns and affective perceptions as well as of insights into how to act upon them.

4 PARTICIPATION IN DESIGN WITH CARE IN TWO DATA COMMUNITIES

Two cases provide examples of support given by a partnering designer to local data management and design during pivotal events at these long-term ecological research sites. In the first case support occurs at the closure of a site-based project and its data system. In the second case, support occurs at the launch of data management following the construction of a new field station. Drawing on Puig de la Bellacasa's ideas of 'doing and intervening', 'material vital doing' and 'affective state' [1], an overview of each case is followed by a description of 'intervening' in the form of creating collaborative processes, joint 'material vital doing' as activities with output products, and the 'affective state' in caring by those involved in data work. These products were designed to be multi-purpose in addressing both 'design-for-use' for problems at hand and 'design-for-future' or product re-use incorporating long-term thinking [44].

4.1 The EcoPrairie Case

EcoPrairie is a research project studying ecology of a grassland with over 60 individuals in its 2014 participant list. Designated a government-owned study area in the United States in 1937, the sampling site has a historical role in rangeland studies supported by a collaborative array of government, academic, and non-profit researchers together with locals working the land. Site-based data management developed starting in 1982 with the launch of the EcoPrairie site as a US National Science Foundation (NSF) funded member of the US Long Term Ecological Research (LTER) Network based at the nearby university. Known within the Network as the Shortgrass Steppe LTER (SGS LTER), it is referred to as EcoPrairie in this study. Over 32 years, EcoPrairie coordinated project research in addition to conducting cross-site research as a member of the network. The US LTER Network started in 1980 with six sites and gradually grew to include twenty-six sites in 2014 studying a wide variety of ecosystems. Due to its focus on long-term research, a long-term funding model was developed by NSF for the program that provides continuing funding to network sites in six-year increments that are subject to review.

Starting in the pre-internet days of the 1980s, the LTER commitment to data management required each LTER member site to budget for a designated data management role. Data management developed gradually at each LTER site over time from coordinating data best practices to creating a local data system for assembling and managing the site's data collectively. By 2000, EcoPrairie packaged data from a local system for submission to the LTER network information system [50]. When EcoPrairie lost funding and was given a two-year closing period ending in 2014, data activities shifted dramatically to focus on

digitization of artifacts, dataset preservation, data migration, and collection formation. It was at this time I became a 'partnering designer' with the data manager as a data ally.

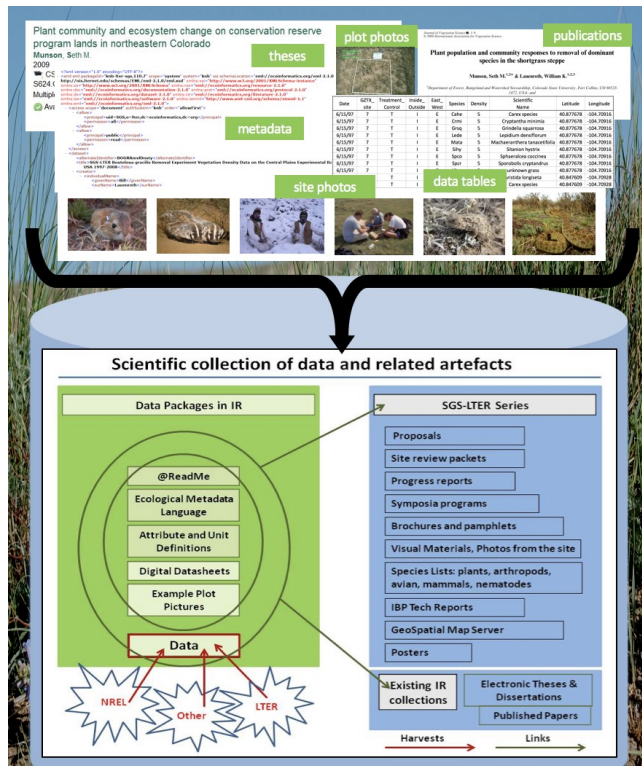


Figure 1. Overview of the EcoPrairie project collection formation. From [51, 52].

4.1.1 *Care and Innovation with Data Migration.* Data-related concepts and products were developed during the EcoPrairie closing period supported by a final two-year funding supplement that described final supported activities. A key activity was identified as use of funds for 'continued participation in the larger information management context'. Having identified plans relating to the broader data landscape, the EcoPrairie data manager wanted to avoid losing information learned during the project and to ensure access to it so went to the extra effort of taking responsibility for preserving additional project data artifacts, beyond the NSF requirement to deposit individually packaged datasets with the LTER Network Information System.

As EcoPrairie members cleared out shelves and offices, the data management team considered options, investigating the university's library and archive services to pursue digitization of community artifacts such as field notebooks, technical reports, and photos. Working with the library, the idea of forming a site-based digital collection within the institutional repository evolved. Insight matured regarding how a collection of project artifacts would capture a broader research context and support interpretation of datasets submitted elsewhere.

A project collection is an innovative concept not previously discussed by the LTER Network information management

community. My EcoPrairie ally took the initiative to share her vision of a project collection with EcoPrairie project management as well as those overseeing the library digital efforts. She identified participants for a working group - two recently hired library data specialists and myself - providing group leadership for more than a year. The effort was designated a pilot study by the library since it was their first scientific project collection. The upper portion of Figure 1 shows a number of research entities that become digital artifacts by being funneled into the structured formats needed for incorporation into a data system shown in lower portion. The pilot study addressed both packaging data for the LTER Network Information System so that it could be harvested (lower left side, Figure 1) and organizing additional materials assembled as the EcoPrairie repository series or within existing collections of the university Institutional Repository (IR) (lower right side, Figure 1). In addition to creating a project collection, the data manager and colleagues took the extra step of documenting the process of data migration in two data-related products described below.

Output 1: A professional conference poster. The first product of the data working group was a conference poster. Upon hearing about a poster that I was making for a professional conference on digital curation, the working group members decided to create a poster about our data migration pilot study. Their request for travel support raised awareness of this as professional work. The EcoPrairie project office and the campus library agreed to support conference attendance, recognizing it as professional development. Poster discussions helped make design decisions of the data working group explicit [52]. Poster making included identification and articulation of goals, challenges, and the bigger picture associated with migration of data from a local data system to a remote archive. The poster effort drew out and integrated our individual understandings, revealing a number of embedded assumptions in library and scientific research views. With the long-term view and broader context in mind, the poster was also discussed with management and ultimately hung on a wall seen often by graduate students.

Output 2: A technical report. The second working group product was a technical report. The group was not familiar with the concept of a technical report when I suggested it so the purpose for such reports was discussed prior to what became a year-long, collaborative activity carried out in parallel with the pilot study. The report [51] was added to the online version of the EcoPrairie collection [53]. The report helped us organize thoughts about term definitions and document workflows, and then to review and reflect upon the data packaging. It provided a place to document issues encountered and to formulate lessons learned. In writing together, we discovered differences in understandings that required negotiation. Generating the report brought clarity to our thinking as we addressed issues existing at the boundaries of the natural sciences, information sciences, and library sciences. A list of site-based data management closing activities was included in the technical report. Two other US LTER sites that had been terminated subsequently used the report as a guiding agenda with its set of prompts about under-discussed topics important to consider during a closing period.

4.1.2 Data Ally Caring. The actions of the data ally in the data migration story are an example of working beyond defined requirements in the caring interest in both preserving data and a project's legacy. Planning began with framing data management in the final supplement in a way that permitted creativity and new forms of partnership. Developing a library partnership brought expertise and infrastructure needed to capture digitized project artifacts as well as born-digital documents that provide information on the knowledge generated over the years by project researchers. Partnering with university technical services supported external access to datasets, a non-trivial technical issue. The long-term view of preserving artifacts and capturing the context of datasets to inform future interpretations of data was identified as a data professional's responsibility by the EcoPrairie ally. The scholarly products generated increased the professionalism of participants involved. Product generation also served as a translation and validation tool in the exchange of information across the boundaries of scientific research and an academic library developing digital capabilities.



Figure 2. Whiteboard doodle of exploring submission of data to more than one repository (left), an idea included in the poster used by data working group for communicating with library managers (right).

4.1.3 Partnering Designer Caring. Interventions in this case include the introduction of new concepts as well as discussions of history and context. They show my interest in documenting site-based activities in addition to supporting local collective data management. The engagement of a partnering designer familiar with research data work and information science set the stage for synergies such as the design of a poster that articulated the working group's vision and contributed to their professional development. At my suggestion, we presented the poster locally to selected library managers (Figure 2). Using the poster as a prop, working group members contributed stories of formation of the project's data collection and of issues involved in its migration to the institutional repository. The library subsequently collaborated with other researchers using our work as an example of scientific project collection making. The technical report, in turn, provided a prompt for exploring concepts relating to collections, project closing metadata, and relations between repositories. When troubles arose such as with data residing in two locations and with non-membership in the network, I was able to serve as a sounding board and to propose various response alternatives.

The list of closing activities captured the data care activities involved in ending a project's local collective data management.

It made actions visible to others confronting similar circumstances and potentially inspiring them to think outside-the-box of assigned requirements. Further, the list revealed efforts of a data manager who was suddenly an outsider to the LTER Network and its data management community. My periodic inquiries into the history of project events elicited information that prompted reflection and clarified legacy as well as current data practices.

4.2 The EcoRiver Case

EcoRiver, a wetland preserve along a large river, is dedicated to ecological studies, restoration science, and conservation through use of scientific management. Research began in the area in 1858. Land eventually purchased by the Nature Conservancy was designated the Emiquon Nature Preserve in 2000. A multi-sector array of partners study in this preserve that is one region in a patchwork of preserves across the United States owned by this non-profit organization. To strengthen ties with academic researchers, the near-by university followed up on an invitation to build a new field station on the preserve. Awareness of data management began in 2010 with work on an NSF proposal for a field station planning grant that required inclusion of a data management plan. Data management plans included establishing internet connectivity at the new field station, streaming data from the field to the web, targeting use of a metadata standard, and providing local data storage for researchers. EcoRiver is a community in the process of identifying digital strategies for assembling data collectively. During this study, conceptual tools and vocabulary for local data work were developed and pilot data efforts initiated.

The field station proposal prompted researchers to seek help in data management which led to an invitation for my participation. EcoRiver's interest in holding a community data stewardship workshop exposed them to data management concepts needed in planning next steps in their data management strategy. Three researchers were data allies who partnered with me for periodic field visits, virtual interactions, and participation in annual preserve symposia.

4.2.1 Care with introducing data management. After having worked together for several years, two researchers affiliated with EcoRiver suggested we three form a working group to organize a workshop introducing data management to the research community. We conducted surveys before, during, and after the workshop to gather views on existing data practices. Rather than calling it a data management or data curation workshop, my data allies chose the term 'data stewardship' for the event in order to build on EcoRiver management's familiarity with the concept of land stewardship that captures the sense of long-term responsibility for well-being of the land. By analogy, the aim with the event name was to convey long-term commitment and responsibility for data care.

Expectations were high with researchers thinking about a comprehensive dataset catalog despite the lack of basic components such as a complete list of sampling locations. The workshop ensured data work associated with a new suite of sensors streaming data from the gate constructed in the levee

between the river and the lake would be recognized as ‘data management’, that is, more than a set of technical tasks. Similar to Figure 1, Figure 3 suggests in the upper portion the lake-river gated system data ‘funneled’ to the lower portion of Figure 3 where measurements follow different data workflows from left to right, before reaching a finalized state ready for sharing.

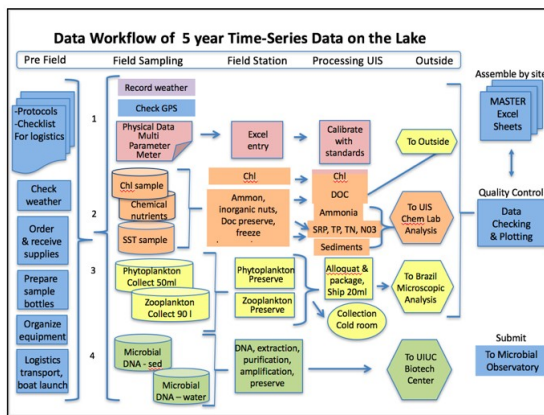


Figure 3. Overview of lake-river levee gate and the drafting of a data schema to hold observations and measurements. From [54].

Output 1: Workshop technical report. At my suggestion, the EcoRiver data team committed to documenting the data stewardship workshop as a technical report [55]. This led to meetings after the workshop in order to ensure a summary appropriate for the attendees, community members, and partners as well as for the organization’s management board. Mutual learning continued as we revisited elements of the workshop. Discussions of data work and data teams frequently conflated data needs of the statewide organization, of a specific region, and of community partners. The plan outlined for a statewide data team was envisioned as raising the level of data management capacity for EcoRiver, other preserves, and partner organizations as well. This hierarchical structure of state headquarters, regional subunits, and member organizations underscored a need for further work on governance issues.

Output 2: Data management job description. The second joint data product was a data management job description shared with the community at the workshop. Discussions about the job began informally earlier at the preserve’s annual science

symposium. The position was eventually approved by the preserve’s board for inclusion in the organization’s five-year strategic plan. Though the support for a data manager was eventually removed due to other budget pressures, the job description planted a seed that could enable future envisioning data management as a process comprised of a variety of potential first steps in supporting collective data assembly. Formal support for collective data management awaits an appropriate alignment of advocates, funding, and skilled preserve staff together with increased familiarity with the diverse infrastructures of all the partners involved.

4.2.2 Data Ally Caring. The work of the data allies in introducing data management to the community provides examples of participants grappling with the issue of organizing and sharing data. Inviting data managers and information scientists to meetings creates opportunities for building trust in addressing changes in data practices. Workshop preparations created a unique opportunity to carry out translational work among data team participants. Further, the data allies mediate between their partnering designer and the community. Pre-workshop interactions included biweekly virtual meetings of one to two hours for a period of approximately five months. Frequently, I prepared a series of 5-8 slides on data management. We discussed and reformulated slides while identifying topics, outlining the agenda, and clarifying materials. My co-organizers used this information to develop community-appropriate slides. From the sessions emerged topics and strategies salient to EcoRiver participants. Notably, we each assimilated the material into our personal understandings of data work so were all comfortable presenting ideas and materials at the workshop. Time was also allocated to continuing mutual learning after the workshop by capturing what was learned in the technical report as described above.

4.2.3 Partnering Designer Caring. It takes time and care to assess data management readiness with a community and to consider how to identify partners and tools appropriate for their vision and goals. Listening closely to identify community rhythms and interests is critical. An array of interrelated factors exist that propel and constrain data management efforts. My approach to raising awareness included presenting data-centered posters at three annual EcoRiver symposiums. Our approach to writing the data stewardship workshop report can be seen as a situated intervention that supported mutual learning. It was also an extreme form of traditional ethnographic ‘member checking’ in that one of the ecologist co-leaders produced the first draft, and only then did I join in contributing to the report. Submission of the final version to the university institutional repository became a tutorial for data allies to learn about such online portals, to prepare accompanying metadata, and then to execute the upload process. This raised awareness of recently developed external data services that made the report a resource available to all partners in contrast to organizationally held materials rarely available to non-members.

5 DISCUSSION

Puig de la Bellacasa [1] highlights commitment, taking responsibility, affect, ensuring well-being, and persistent focus on exclusion, power and domination. As data practices in the digital age of data preservation and access emerge, those generating field data are faced with designing new practices, showing commitment to data care by considering project collections, holding data stewardship workshops, and documenting new practices as they take responsibility for the well-being of data and thereby of science and its research projects. There is an openness to learning and collaborative community exploration of data options in the two case examples despite difficulties with intertwined scopes and configurations.

5.1 The Partnering Designer Role

As the partnering designer, I bring to the discourse roots in ecological sciences, data management, information sciences, and PD. This background raises responsibility and attachment with data-related discussions such as those concerned with community vocabulary, data management planning, the data ecosystem, and infrastructuring as a whole. Having experience in leading local collective data efforts for long-term research communities, shapes my commitment. From an information scientist's perspective, I have experienced funding and large-scale design as drivers that propel, guide, and draw upon local data efforts in crucial ways despite the frequent failure to recognize data management difficulties encountered in practice as critical issues rather than local troubles. Following Beck's suggestion that all involved articulate their motivations [56], we note that the partnering designer role imbues an affective and ethical disposition and responsibility to nurture the care for data, data work, and data workers by cultivating local collective data management in its design efforts. During this time of digital transitions, engaging with community data management addresses matters of concern and care about assembly of and access to scientific data of quality and the role local data workers can play in growing infrastructure [32] for everyday data work often neglected in science policy and funding of design work.

With a partnering designer, a data ally and their communities gain a partner in data care, critical reflection, and infrastructuring. The data ally in the EcoPrairie case as an embedded data manager is in a similar position to that described as 'in-house designer' and 'liaison' by Trigg and Ishimaru [57] in co-designing databases and digital applications for the Global Fund for Women, though a partnering designer is external to the site-based projects and their participating organizations. These roles depict a proactive communicator, highlight the need for development of common language and liaisons across the community. Furthermore, they speak to integrative and democratization commitments by mobilizing resources and engaging participants across departments and external stakeholders for creating common information spaces in response to the challenge of making data management processes visible.

Partnering designer also resembles some reflective takes that reconsider the PD designer-researcher role. For instance, 'participant interventionist' highlights both ethnographic

participant observation as well as sensitivity in appreciative interventions [58]; 'corealizer' underlines the familiarity achieved and membership established by the longitudinal presence of a designer to do their work *qua* member [59]; 'designer-researcher' stresses the reflexivity of the hybrid role to address the plurality of participations of all involved [60] and attention to critical reflection on care in PD practices and social relations [35, 61].

Undertaking a study using a partnering designer's 'thick involvement' and a 'matters of care' commitment is intended to be neither prescriptive nor imperious but part of a speculative future. By 'doing and intervening' [1], a partnering designer creates spaces, joint material 'doings' and collaborative processes where care and responsibility for data are enabled. The interventions described are in some ways similar to and in other ways different from the more typical PD methods and techniques [62, 63], suggesting recognition of a broad repertoire of ways to intervene in relation to infrastructuring. Further, the role of partnering designer represents an opportunity to give back to the community, in accordance with the values of PD and ethnography [46]. And finally, this support addresses the politics of making visible local collective data management as a 'neglected thing' [1].

5.2 Nurturing the Design of Local Collective Data Management

Nurturing the design of a 'neglected thing' necessitates a wide variety of 'doings' and 'interventions' as described above in relation to the two case studies. It starts by getting to know the local situations through immersion and then figuring out with local allies what would help them in raising awareness, learning, partner seeking, making connections, etc. for recognition and design of local collective data management efforts. We discuss here four kinds of nurturing doings and interventions with which a partnering designer is able to support data allies and research communities in developing digital expertise and community digital capacity in data care and infrastructuring: 1) mutual learning, 2) joint critical reflection, 3) attending to extended processes and scopes, and 4) co-creating.

In both cases, *mutual learning* occurs throughout planning, review, and debriefing associated with an event or interaction. Aligning with the idea that caring creates relation(ship)s [1], we understand mutual learning for both data allies and partnering designer as inclusive of learning both *from* and *with* each other, cf. [64]. The partnering designer served as a 'sounding board' during difficult times or a resource for thinking about alternatives such as potential partnering, scholarly products, and professional venues. In addition, a data ally and partnering designer may learn together and develop a new, shared understanding when action is needed on a data issue such as data migration or the launch of data stewardship at a site. With interactions that focus on site-based circumstances, learning occurs in conjunction with local planning, action and design.

Joint critical reflection often arose in the two cases in response to changes in the digital environment, for example with the introduction of new concepts such as 'data sharing', 'data

stewardship’, and ‘data repository’. In these instances, mutual learning became intertwined with joint critical reflection. A similar combination of learning and reflection occurred several times when a question was posed as to whether an action was required in response to a local situation. At times an alternative perspective formed in interactions during data design work carried out collaboratively and led to a community member conceptualizing and conducting design work with a broader view of available options and the larger data landscape. As an outsider with translocal experience, the partnering designer was sometimes able to mitigate anxiety and offer a perspective of data care politics in these situations by initiating discussions on whether an event was a local ‘trouble’ to overcome or a larger-scale ‘issue’ that required community level involvement [65].

The third aspect of nurturing the design of local collective data management comes through *attending to the unfolding processes and multiple scopes of data and their infrastructures*. The notion of infrastructuring, in addition to referring to ongoing activities, e.g. [12], denotes relating and connecting up with partners and aligning with other relevant digital structures [66]. For instance, already in the beginning at EcoPrairie, in response to concerns about long-term care and use of data, the process of infrastructuring involved assembling the data of the community and creating a data system to manage the data. Features were added to the system over the years. Even at project closing, infrastructuring continued and made use of existing infrastructures and in designing new kinds of data support.

Infrastructuring was a demanding relational task fraught with challenges relating to interdependencies, alignment, and change as well as with the need for partners and for consideration of new kinds of distributions of labor. EcoPrairie infrastructuring resumed via finding a suitable partner and establishing partnerships such as with the library where discussions started with digitization of reports and photographs and expanded to formation of a project data collection to be held in their archive. Partnering with campus IT services provided delivery of the community’s website and public access to data. Thus, designing for local data collectives involved use of local and non-local or external services. More generally, infrastructure work is a process that large-scale planners refer to as building infrastructure while local data workers nested within layers of arrangements speak of growing an infrastructure [32]. The term infrastructuring suggests infrastructure is never complete; it is always being developed, stabilized, or transformed.

Finally, *co-creating* involves joining together in material ‘doings’, which in our cases meant jointly identifying and working on scholarly products. It is a process that fosters mutual learning and critical reflection during production of an outcome. Data care is the focus of a continuing discussion that refines understandings and serves as a forum for comparative cross-checking of data that represents a proactive approach to pursuing potential conceptual discrepancies and differences in vocabulary. Discussions carried out during the co-creation process offer opportunities to clarify issues, validate understandings, and enrich interpretations in addition to creating occasions for participants to reflect upon processes,

transformations, and actions. The process of co-creating provides new insight that is available immediately to inform everyday data work.

The partnering designer focused on finding ways to both contextualize and document ongoing activities using approaches relevant for the communities involved. Our work illustrates participatory design activities that proved crucial to developing practices of ‘data care’. These activities contrast with traditional PD techniques and outcomes such as prototyping, mock-ups, future workshops, and organizational games. In the case of scientific communities, pertinent outcomes include conference posters, meeting presentations, and technical reports that can be shared with colleagues and broader audiences. They contribute in important ways to articulating and making data work visible. In addition, these products contribute to the professional identity of data allies. They provide an outlet for data specialists interested in data work as a profession with principles, research methods, and specialized training. The growing number of roles and participants that carry out design relating to data arrangements and to the doing of data work - data management, data science, data curation, information science, data analysis, software engineering, library science - are frequently a neglected part of the data infrastructure given their limited career trajectories typically found within organizations.

5.3 The Politics of Designing for a ‘Neglected Thing’

Today’s Big Data discourse typically marginalizes the issue of support for local data management as illustrated by the EcoPrairie and EcoRiver case examples. There is a failure to recognize the dynamics and continuing innovation of local digital environments that abound and teem with diversity of data, data configurations, and divisions of labor, particularly in the field-based natural sciences. We return to Trigg and Ishimaru [57] with their discussion of workplace democracy with its highlighting of power and dominance. Our data activities and their documentation aimed to inform as well as empower data management efforts and decision-making by making local capabilities visible in science-led networks. The data ally-partnering designer approach supported continuing learning and outcomes that included reporting on data-related transition activities and project collection creation as well as identification of unresolved, network-wide issues such as the submission of the same data to more than one repository.

There is political significance to adopting an inclusive view with large-scale data centers as one type of agent in a broader data landscape that has numerous interconnected components of infrastructure made up of overlapping data work arenas populated by many data workers, including the ‘neglected thing’ of local collective data management. A commitment to care for data and data management in relation to this broader landscape represents an attempt to enrich and diversify the worlds of data work and infrastructure design. Engagement with this landscape was demonstrated by EcoPrairie’s partnering with library staff and by EcoRiver through development of a job description for data management intended for presentation to a Science Board.

Participation as a partnering designer is political work. In the rhetoric of the digital age that aims to move from grand challenges to big ideas, the notion of ‘matters of care’ provides a way of thinking and exploring how care for data work and design are carried out and how data arrangements represent a political issue. A caring approach with an ethico-political inclusiveness of data participants and work arenas across the data landscape can be described as transformative and lead to innovations such as the EcoPrairie development of a project collection beyond existing data closing requirements. It provides a ‘critical sensibility’ [1] in exploring data politics and speculating about how a mix of data work arenas, community centers, national centers, and archives might look when all those impacted by digital infrastructure planning can participate in designing the future of digital data environments. This thinking goes beyond the notion of highly functioning data workflows to consider how the fluidity of scientific knowledge making as well as data making – with their inquiry-related divergences, meanders, and eddies – can be recognized and maintained amidst today’s infrastructure planning for the sciences.

Algorithms and automated workflows frequently reduce and/or erase the human contributions to data work of data specialists and scientists alike when local engagement is lacking. Beyond centralization, designing for rapid feed-back within local data arenas enables participant review, interpretation, and cross-checking of data given the variety of differing workflows as illustrated for EcoRiver (Figure 3). Further, overly efficient data streams may disrupt existing practices involved in generating small or mid-size datasets crafted by experienced hands for question-driven scientific inquiry. It is frequently in local environments that data anomalies are spurs to scientific understandings and are studied rather than ‘harmonized’ and thereby erased from a dataset packaged for dispatch to an archive.

The notion of ‘matters of care’ is evocative in exploring local data work in the cases presented here. The notion of care relating to an active participation highlights the often-neglected particulars of local data work with documentation in both cases prompted by a partnering designer. Local collective data management complements larger-scale efforts, adding situated analysis and creativity to the generalization often introduced by data harmonization and integration at large-scale data facilities. This is a political move that includes marginalized groups. Those without the opportunity to develop local data collectives or working standards, may become dependent on remote services and systems rather than poised to develop local skills and infrastructure in the digital era.

Whether dealing with design of automated and remote services or local data arrangements, subjecting them to ‘thinkpolitics, we are reminded of the need for and the value of the role of ‘human infrastructure’ [67] and of the ‘human-in-the-loop’ [68]. Across the variety of scopes of infrastructure, it is humans who have the ability *and* the agility to modify or abandon an existing procedure in the pursuit of new knowledge in order to ensure care and creativity continue to play a vital role in research. Care in work with local data raises awareness of the

work involved in creation of quality data and the implications of the design of data production processes.

6 FINAL REMARKS

Thinking with ‘matters of care’ provides a way of considering the forms of participation that contribute with affective and ethical commitment to the formation of local data arrangements. This investigation of data work at two ecological research sites develops a ‘partnering designer’ as an intervening role that commits and takes responsibility with data care and its political agenda in designing together with community members for local collective data management and its relations with the other arenas of scientific data infrastructures. Scientists, data managers, and partnering designers are political actors in cultivating local collective data management. They are contributing to the redistributions of data work beyond hierarchical, centralized models. Rather than becoming marginalized voices, participants associated with generation of the data contribute alternative perspectives on data needs and new requirements that emerge while working with the data. Their inclusion precludes development of gaps in awareness, experience and learning about data as well as in sociotechnical arrangements and capabilities.

Puig de la Bellacasa [38, p. 43] reminds us that “to care is vital in the worlds of naturecultures and technoscience”. ‘Matters of data care’ in scientific workplaces refers to more than the virtue of hard work, available expertise, or smart choices in data arrangements. Partnering designers and data allies together with many others working with data in the natural sciences, share care for the well-being of science, nature, and life on earth. In addition to support for local collective data management and drawing attention to local infrastructure as a neglected thing, there are overarching cares still to be explored including contributing to the scientific pool of knowledge, participating in the quest to understand natural systems, and maintaining personal connections with nature, cares that lead us to ask “How could PD engage more?”

The notion of matters of care contributes to transformative thinking about data work. We return to Puig de la Bellacasa [1, p. 100] for some final remarks: “caring is not an option but a vital necessity in our technoscientific world ... nothing holds together in a liveable way without caring relationships.”

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