Summary of archiving practices
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This document contains a summary report on the archiving practices employed by a sizeable subset of the soil C research community. It is intended as a generalized source of information for researchers wishing to begin a new archive or modify their approach to archiving in light of consensus practices employed by the community. As with the design, implementation, and interpretation of any soils project, the specific practices to use in archiving will vary, and may depart from these summarized practices depending on the objectives of the project. In this regard, this document is only an aid and a starting point; stay apprised of the "Soil archiving practices" discussion thread on the ISCN Forum where members of the community can discuss caveats, important considerations, and lessons learned.

I. Sources of information

The information contained in this summary report is derived from 46 responses to the archiving questionnaire on the ISCN website. The responses were submitted by 41 individuals between spring 2011 and winter 2015, and describe the properties and practices employed in the curation of 44 distinct archived soil collections. These "archives" range from *ad hoc* collections of research samples in spare lab or storage space, to formal, cataloged and curated facilities holding samples from many projects and contributors. The following sections summarize the properties of these archives, in the hope that the summary information will be useful to members of the community seeking guidance on consensus practices. It is important to note that this survey, while essentially a statistical subsample, is not a random cross section of the entire soil C research community as many of its responses are derived from individuals with a strong commitment to sample archiving. In this regard, while it may not reflect the research community at large, the fact that the responses come from dedicated individuals means that they likely represent best practices.

II. Identity and status of archives

Among the 44 archives described here, most (52%) are associated with researchers and facilities at U.S. federal agencies (Table 1). 43% of the archives are maintained by faculty and research staff at Universities, while just 5% come from nonprofit institutions (one of these representing the only non-U.S. response).

Organization type	Count
University	19
Nonprofit	2
US Federal Agency	23
USDA-FS	(14)
USDA-NRCS	(3)
USGS	(3)
DOE	(2)
NPS	(1)
	n=44

Table 1. Distribution of archives by organization type.

The number of samples held in each archive varies, though this variance is not related to the institutional location of each archive. Most archives hold either hundreds (51%) or thousands

(42%) of individual samples; archives containing only tens, or tens of thousands of samples are less common (Table 2). Among the respondents in the survey (n=41), 67% expressed moderate to strong interest in being involved in a community approach to soil archiving, such as participation in sample round-robin analyses, provision of storage space to at-risk samples, or the contribution of sample information to a centralized database of soil archives available for sharing. 33% were not interested in participating in such efforts. Independent of any future development of a community soil archive, 79% of all (n=44) archives are open to sample sharing with other researchers interested in acquiring samples for cross-site comparisons, new analyses, etc. Because one of the principal motivations for this survey was determining what factors threaten the continuation of existing archives, respondents were asked to estimate the level of risk that their archive may be lost, and to describe the most likely causes. Over half (54%) of archives are at moderate to high risk of being lost in the next several years, while 46% are viewed by their curators as having low likelihood of loss. Among the archives at risk of loss, the principal causes are loss or deterioration of storage space (53%) and retirement (21%).

Archive size	Number of archives			
(# samples)	Count	Median	Min	Max
10-100	1		96	
100-1000	22	300	100	1000
1000-10000	18	2000	1000	8000
10000-20000	2		12000	14400
	n=43	**620**		

Table 2. Distribution of archives by the number of samples held in each collection.

III. Archiving practices

Researchers conserve a wide range of sample amounts in their archives (Table 3). As with the size of individual archives in terms of the number of samples, the amount of sample mass saved follows a roughly normal distribution, with most archives (54%) holding between 100 and 500 g of sample (mineral soils). Within an individual archive, the masses of individual samples often vary substantially according to the type of material (*e.g.*, O horizons vs. mineral soils), project motivations, space limitations, or the mass requirements for different preparations or analyses. Except for one archive, which holds refrigerated, intact cores, the archives described in this summary contain samples that are the individual layers comprising deeper soil profiles. Whereas only 21% of the archives contain samples that are systematically sampled depth increments from a profile, 35% of the archives contain samples collected by genetic horizon. An additional 35% of archives contain a mixture of samples collected by these two methods, while <10% have samples that were collected by a hybrid approach (*e.g.*, O and A as genetic horizons, with 10 cm depth increments beneath). In terms of the maximum sampling depths, deep profiles or full-solum pedons appear to be the norm (Table 4). 52% of archives contain samples that extend to the C horizon (if sampled by genetic horizon) or have a maximum profile depth between 50 and 100 cm. An additional 23% of samples extend below 100 cm,

Sample mass	Number of archives			
(g per sample)	Count	Median	Min	Max
1-10	1		8	
10-20	1		10	10
20-100	7	50	26	90
100-200	12	150	100	200
200-500	9	350	250	500
500-1000	6	700	500	1000
1000-2000	2		1300	1500
2000-5000	1			2400
	n=39	**150**		

Table 3. Distribution of archives by the per sample mass of curated samples (for mineral soils).

some to depths as great as 500 cm, while archives holding only surface soils (only A horizons or increments from the upper 20cm) are relatively less common.

Maximum sampling depth	Number of archives
A horizon	1
C horizon	10
≤ 20cm	4
> 20, ≤ 50cm	4
> 50, ≤ 100cm	11
> 100, ≤ 200cm	5
> 200, ≤ 500cm	4
	n=40

Table 4. Distribution of archives by the maximum sampling depth of individual soil profiles.

Most archives hold soil samples that have been through similar processing procedures, although there is more variation in the types of containers and storage conditions employed on a per-archive basis (Table 5). In particular, archived samples are typically air-dried, which was the case 80% of the time that this information was provided. The other 20% of the time, oven drying (more often 65 than 105 C) was used in sample preparation. Over 96% of samples stored in archives have been sieved and represent the fine earth (<2mm) fraction; O horizons are not always sieved but when they are the mesh size is more often ~ 6mm. Few responses provided information as to whether individual samples had been ground; however, no respondents stated that samples had not been ground, while 8 stated that grinding was the norm.

Storage practices	Number of archives					
Samples are dried	**n**	**No**	**Yes**	(Air)	(Oven)	(Unknown)
	34	1	33	(24)	(6)	(3)
Samples are sieved	**n**	**No**	**Yes**	(2mm)	(3mm)	(Unknown)
	29	1	28	(10)	(1)	(17)
Samples are ground	**n**	**No**	**Yes**			
	8	0	8			
Sample storage media	**n**	**Glass**	**Plastic**	**Paper**	**Multiple**	
	20	7	13	4	6	
Storage container type	**n**	**Jar/vial**	**Bag**	**Box**	**Multiple**	**Other**
	31	13	7	4	6	1
Climate control	**n**	**Yes**	**No**			
	25	20	5			

Table 5. Storage conditions and practices on a per-archive basis. The total number of responses to each question (n) is shown, as well as the distribution of responses among the most common practices.

Samples are stored in a range of container media and types. Plastic and glass are the most commonly utilized media, with vials or bags the most common container types. The majority of containers were plastic vials or bags and glass jars; paper boxes (in particular ice cream cartons) are less common but widely utilized. Of 43 sample collections providing the information, 63% have a database that catalogs the individual samples (37% do not). This illustrates the level of integration and formalization of the archives in this survey, and suggests that one important part of achieving a community-oriented, distributed archive system is to develop a common database or to link individual databases so that individual samples can be discovered, shared, and their data stored along with information about provenance, methods and archiving practices.