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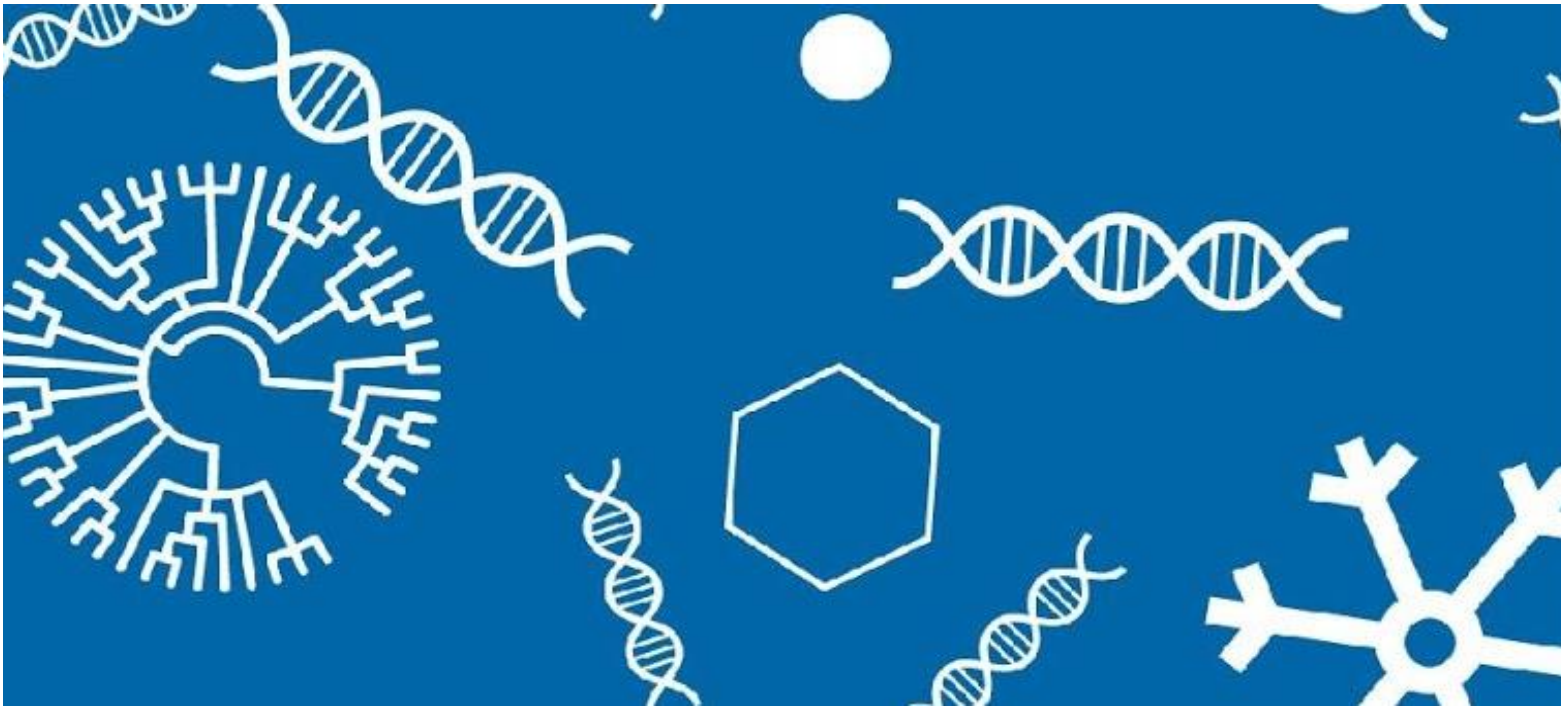

How to Conduct an Inventory of your Sample Collection

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CRYOARKS

Product of CryoArks Partner: NATURAL HISTORY MUSEUM

This document will cover:

Why conduct an inventory of your collections?

a The scope of this document

This document aims to provide guidelines for how to conduct an inventory of molecular collections to any who hold and/or are responsible for a collection of either tissue samples, DNA/RNA extracts or cell lines. These guidelines may be useful to you whether or not you intend to make your samples accessible, by sharing your collection data through the CryoArks Specify Database or by transferring your samples to one of the CryoArks hubs (either at the Natural History Museum in London or at National Museums Scotland in Edinburgh).

Our workflow has been developed based on the extensive experience and expertise of the CryoArks team and its partners. Although this document provides a procedure for conducting an inventory, there may be other ways of approaching this that would be useful to you, but we hope you find the workflow helpful to get you started.

b What is an inventory?

In the context of a molecular collection we define an inventory as an itemized list of samples that you hold complete with their associated metadata. An inventory should be able to tell you what you have and where is it in the freezers. In its most basic form it may not list every individual sample, but contain an overview of groups of samples (e.g. from a specific location, research project or donation).

A complete inventory would include all metadata associated with each sample (the location the animal was collected from, the name of the collector, the

date and method by which the tissue sample was taken, etc.) and its exact location within a freezer. Regardless of how much information you have to start with or how complete your inventory will be (depending on the time you have to dedicate to it), an inventory is worthwhile conducting and maintaining.

c What are the benefits of conducting an inventory?

Producing and updating a collection's inventory is needed for minimum collections accountability. Inventories provide the collections/laboratory manager with essential information on the breadth and depth of a collection. It can provide the registrar with information, e.g. for insurance purposes, help alert staff to possible collections needs, it can inform strategies to augment the collection and even aid in the management of storage space in research laboratories. With the development of new regulations, maintaining an accurate and up-to-date inventory will help enable you to remain compliant with current legislation, including the Nagoya Protocol on Access and Benefit Sharing.

In addition to these key benefits, knowing what you have will enable you to capitalise on the unique features of your collection, e.g. the value of your samples due to their uniqueness or rarity. Furthermore, you would be able to publicise your collection and enable the research community to benefit from it by allowing access. Thus, those samples that are currently not being used, but which are sat at the back of your freezers, could help support new research. Whether you ultimately choose to include your samples and/or the data in the CryoArks initiative, conducting an inventory is a key first step to realising your collection's potential.

Conduct a basic inventory

Not everyone has access to an army of able and willing students / staff / volunteers to help conduct an inventory, so many of you will be fitting it in around other responsibilities. We recognise this and have put together a procedure which will help you to break the task down into more manageable stages. These stages are shown in our workflow in figure 2.1 and described in detail in the sections below. Whether you are just intending to get an overview of what you have, or would like to record each individual sample in detail, this workflow will get you started.

Figure 2.1: The workflow shows the three main steps and the required information per step to conduct an initial inventory of your collection.

a Where to begin

Regardless of whether you are starting from scratch, or have a good idea of what is where, the first thing you need to do is make a plan. Start by listing the curation units you know are in your collection. We define a curation unit as a group of samples that have a key thing in common and can be viewed as a single component of your collection. It could be that your collection is broken down into research projects, fieldwork locations, taxonomically, or by the people who have donated the samples to you. Whichever way your collection is compartmentalised, list the most logical curation units for your situation. This will highlight how much you are already aware of. You may even have a unit of unknown samples, if there is a group of samples in your freezer that you don't know anything about (except that they are taking up space).

Once you have your curation unit list, the next thing to do is assess how much information you have about each curation unit. A simple way of doing this is to answer the following questions for each curation unit and input the data into a spreadsheet; see figure 2.2 for an example of how this may look.

- **How many samples does the unit include?**

An approximate number is fine, it might be easier to categorise it.
e.g. < 100 / 100 - 1000 / >1000.

- **What does the unit contain?**

A brief description of the samples.
e.g. taxonomic groups, geographic location and/or notable feature.

- **Do you have any metadata for the sample?**

Yes - In a Collections Management System / Yes - Spreadsheets / Yes - On paper
No - None that I know of.

- **Do you know where the samples are?**

Yes - Exact location / Yes - Rough location
No - But I know they exist / No - I'm not even sure they are still here.

- **Do you know who owns the samples?**

The name and contact details of the person who retains ownership of the samples. If it is not yourself.

At this point you have not entered the freezers, you are simply assessing where you are able to start. From this information you can prioritise what curation units you may be able to inventory quickly, what would be worth sorting first (e.g. those you have a lot of information on and know at least roughly where they are) and those that are low priority (e.g. if they have very few data associated with them, or if they are of lower value in terms of uniqueness, rarity, research interest, etc.). Now reorder the curation units by priority and the level of investment needed in terms of time and effort, the quick wins are often first.

	A	B	C	D	E	F	G
1	**Priority**	**Curation Unit**	**Number of Samples**	**Contents**	**Metadata**	**Location Known?**	**Ownership**
2		**Amphibians**	< 100	Tissue samples, specimens from South America including some super rare frogs!!	Yes - Collections Management System (Adlib)	Yes - Exact location (Collections facility, Freezer 3, bottom 2 drawers)	My Institution
3		**Reptiles**	100 - 1000	Mostly DNA extracts of lizards from Africa and Snakes from Australia collected during research project trips	Yes - Spreadsheets	Yes - Rough location (Freezer 5 in Basement)	Joe Bloggs, Hypothetical University, UK
4		**Mammals**	>1000	Extensive collection of tissue samples from a range of taxa including Bividae, Canidae and Felidae.	Yes - On paper	No - But I know they exist (possibly located in the basement room, in wither Freezer 1, 2 or 3)	My Institution
5		**Fish**	100 - 1000	Tissue and DNA extracts of deep sea fish from the South Atlantic	No - None that I know of	No - I'm not even sure they are still here (Possibly on loan to Hypothetical University)	My Institution

Figure 2.2: The format of an initial inventory input into a spreadsheet. The curation units are in the first column and the questions to be answered along the first row. Add as much information to each field as possible. This will enable you to complete the priority column shown in red, which will inform how you proceed with the rest of the inventory.

b Check the freezers!

You have your initial list of curation units and you know which you are going to tackle first. Now it is time to take a look at those freezers!

At this stage do not attempt to individually locate each and every sample (you are probably far too busy to do that). This freezer check is to establish whether the curation units are located where you think they are. Simply check in which freezers and, if possible, in which drawers each collection unit is present, and add this information to your initial inventory. You may discover that the collection unit is much larger that you initially expected, not located where you thought it was, or is not present in your freezers at all.

If you have time while you are searching, we advise that you also make a note of and/or count the number of boxes/bags/other containers that make up the collection unit and add this to your inventory. Also, as you are going along, assess and make notes of whether there are any collections-care needs, e.g. rehousing, relabelling, etc. It is very helpful to the CryoArks team to be aware of the types of tubes (size, brand, etc.) the samples are in. This assessment will help you, if you are going to conduct a thorough inventory, to make provisions for collections-care updates as the inventory is being conducted. See figure 2.3 for how this information may be incorporated into your spreadsheet.

	A	B	C	D	E	F	G	H	I	J
1	**Priority**	**Curation Unit**	**Number of samples**	**Contents**	**Metadata**	**Location Known?**	**Ownership**	**Location Confirmed**	**Containers**	**Care Needs**
2	1	**Amphibians**	< 100	Tissue samples, specimens from South America including some super rare frogs!!	Yes - Collections Management System (Adlib)	Yes - Exact location (Collections facility, Freezer 3, bottom 2 drawers)	My Institution	Collections facility, Freezer 3, drawers 7 and 8	Cryovials in 25 latched and barcoded boxes	None
3	2	**Reptiles**	100 - 1000	Mostly DNA extracts of lizards from Africa and Snakes from Australia collected during research project trips	Yes - Spreadsheets	Yes - Rough location (Freezer 5 in Basement)	Joe Bloggs, Hypothetical University, UK	Found in Basement, Freezer 5, drawers 1, 2, 3 and 4	Eppendorf tubes in 81 well boxes. Approx 60 boxes	Relabelling: Barcode boxes and tubes
4	3	**Fish**	100 - 1000	Tissue and DNA extracts of deep sea fish from the South Atlantic	No - None that I know of	No - I'm not even sure they are still here (Possibly on loan to Hypothetical University)	My Institution	Found in Basement, Chest Freezer 2, Left hand side	5 to 50ml tubes in bags.	Reformating: New cryovials and barcoded racks
5	4	**Mammals**	>1000	Extensive collection of tissue samples from a range of taxa including Bividae, Canidae and Felidae.	Yes - On paper	No - But I know they exist (possibly located in the basement room, in either Freezer 1, 2 or 3)	My Institution	Found Bovidae and Felidae in Collections facility, Freezer 3, drawers 1, 2, 3 and 4 Canidae not found	Mostly cryovials, a mix of 0.75ml, 0.2ml and 0.3ml Cardboard racks, no lids.	Reformatting: into appropriate racks per size

Figure 2.3: The initial curation unit inventory has now been reorganised by priority (in red) and a field for the confirmed location has been added. Additionally, the spreadsheet now includes columns for the number and format of the containers and details of the collection-care needs (also highlighted in red).

c Gather the data

Now that you have done your initial inventory and checked that the curation units are present in your freezers, it is time to gather the data you have for each unit. This includes taxonomic identification, permits (e.g. collections, Home Office, AHVLA, Research and CITES permits), information about the collection/donation and any sample metadata you might have (e.g. collection locations, sampling/extraction dates, associated publications, etc.). As with the freezer check do this in order of priority. You are not matching samples to the data at this stage, you are simply gathering all of the data together.

It can be helpful to have physical/digital folders per collection unit where the associated data can be stored. Be sure to add a column to your inventory spreadsheet showing where the data associated with each collection unit is stored (e.g. by including the file path) and a brief description of what was collated (see figure 2.4 for an example). Work through your curation unit list by priority. All of this gathered information will be extremely helpful both to you for future use and to the CryoArks team to adequately assist you and assess your collection.

Once you have completed your initial inventory, this is the minimum level of information that CryoArks would need to see in order to assess your collection. However, we strongly advise that you consider completing a thorough inventory (a workflow for which is shown in the next section, see figure 3.1), in order to get a better understanding of what is actually present in your freezers.

If you are able to dedicate time, or have the manpower/resources to complete a more thorough collection inventory, please move on to the next chapter. If you are unable to work through your collection any further at this stage, but would like to be involved in the CryoArks Initiative, please move on to chapter 3 and find out how the CryoArks team may be able to help you.

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Priority**	**Curation Unit**	**Number of samples**	**Contents**	**Metadata**	**Data Location**	**Data Description**	**Location Known?**	**Ownership**	**Location Confirmed**	**Containers**	**Care Needs**
2	1	**Amphibians**	< 100	Tissue samples, specimens from South America including some super rare frogs!!	Yes - Collections Management System (Adlib)	Adlib collection database Record number 000001 - 000092	Individual record per sample in collection, 92 records in total all have taxonomy, collector, location and cold chain information	Yes - Exact location (Collections facility, Freezer 3, bottom 2 drawers)	My Institution	Collections facility, Freezer 3, drawers 7 and 8	Cryovials in 25 latched and barcoded boxes	None
3	2	**Reptiles**	100 - 1000	Mostly DNA extracts of lizards from Africa and Snakes from Australia collected during research project trips	Yes - Spreadsheets	C:\Documents\ Collections Inventory\Reptiles	Two spreadsheets: One for lizards and one for snakes Both include taxonomy, collection location and collector	Yes - Rough location (Freezer 5 in Basement)	Joe Bloggs, Hypothetical University, UK	Found in Basement, Freezer 5, drawers 1, 2, 3 and 4	Eppendorf tubes in 81 well boxes. Approx 60 boxes	Relabelling: Barcode boxes and tubes
4	3	**Fish**	100 - 1000	Tissue and DNA extracts of deep sea fish from the South Atlantic	No - None that I know of	C:\Documents\ Collections Inventory\Fish	Single spreadsheet with a list of taxa collected	No - I'm not even sure they are still here (Possibly on loan to Hypothetical University)	My Institution	Found in Basement, Chest Freezer 2, Left hand side	5 to 50ml tubes in bags.	Reformating: New cryovials and barcoded racks
5	4	**Mammals**	>1000	Extensive collection of tissue samples from a range of taxa including Bividae, Canidae and Felidae.	Yes - On paper	Cabinet 1\ Drawer 3\ 5 x Green folders named'Mammal collection Data'	Data collection sheets per sampling site which include the taxonomy to genus, the collection location (GPS) and the collector (initials only)	No - But I know they exist (possibly located in the basement room, in either Freezer 1, 2 or 3)	My Institution	Found Bovidae and Felidae in Collections facility, Freezer 3, drawers 1, 2, 3 and 4 Canidae not found	Mostly cryovials, a mix of 0.75ml, 0.2ml and 0.3ml Cardboard racks, no lids.	Reformatting: into appropriate racks per size

Figure 2.4: The initial curation unit inventory, now including the location of any associated data (digital and/or physical) and a description of the format and content of the data (shown in red). An editable template of this data sheet is available through the CryoArks website.

Conduct a thorough inventory

Be sure you have completed the curation unit inventory in section one before beginning this section. Your initial inventory will form the basis of the rest of the sort and help you best direct your time and investment.

If you have the necessary resources to complete a more thorough inventory of your collection, or your collection is of a size and state that you are able to complete a full inventory yourself, then please follow the next sections and see figure 3.1 for an overview of the workflow.

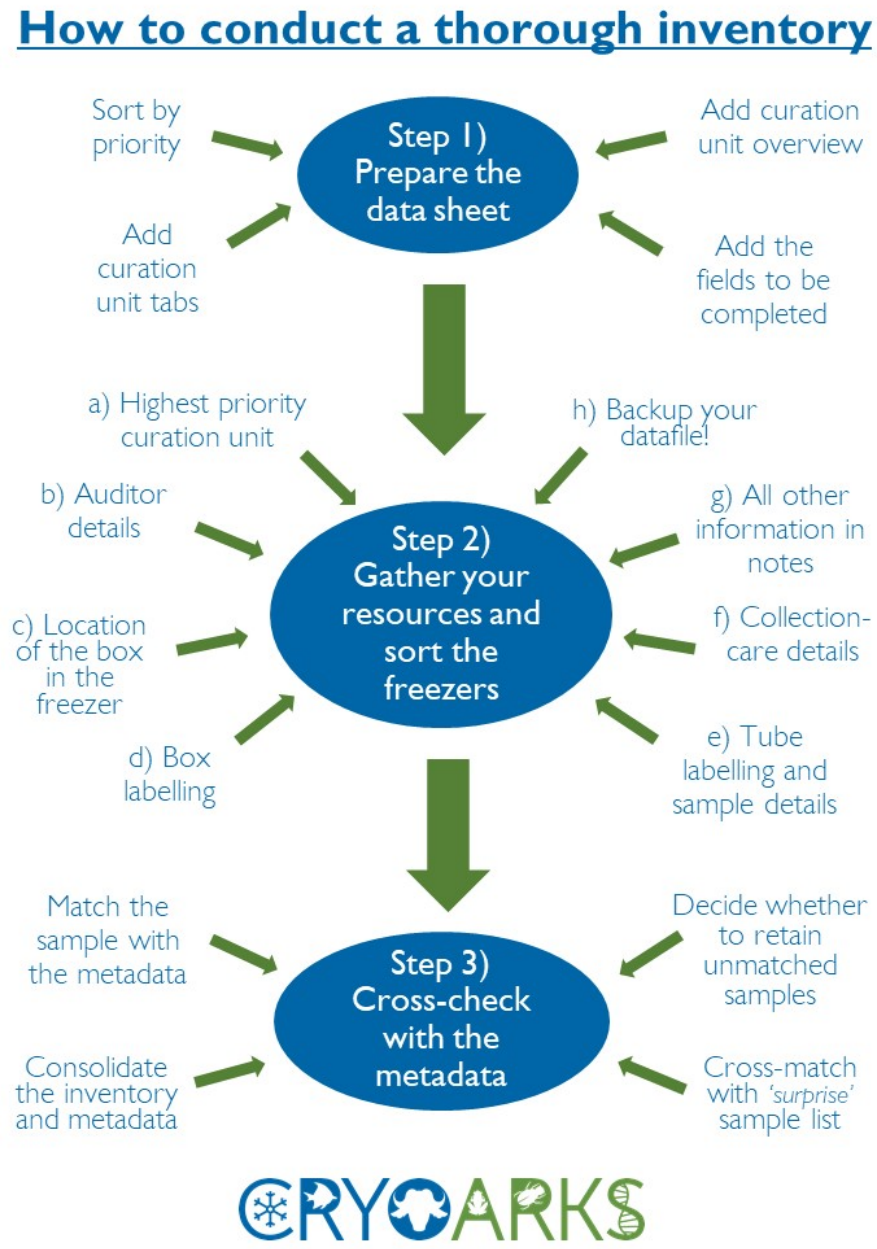

Figure 3.1: This workflow details the steps necessary to conduct a thorough inventory of your collection. This assumes that you have already conducted a basic inventory and are aiming to sort through your freezers sample by sample collating the relevant information and making any necessary collections-care updates. A thorough inventory will also enable you to gather information on any miscellaneous aka '*surprise*' samples.

a Getting to know the curation units

Firstly, ensure that all members of the team have completed all necessary health and safety training, are familiar with all relevant risk assessments and COSHH forms, and have the appropriate personal protective equipment to handle the samples. Secondly, you will need to ensure that you have the resources available to handle the samples appropriately (e.g. dry ice if handling frozen samples which have been stored at -80°C or in liquid nitrogen), in order to maintain the cold chain and/or their integrity in their storage buffer, etc.

If from your initial inventory you have identified any collection-care needs, e.g. reformatting of samples into more appropriate tubes, or adding barcoded labelling, etc., it can be helpful to do this while the sort is being conducted, reducing the need to handle the samples again. Therefore, be sure to have gathered/purchased any and all relevant resources necessary for collection maintenance before beginning.

You will need to familiarise your team with the curation units that make up your frozen collection. Describe the priority units and the assessment of effort needed to complete a full inventory of each unit. Tour the freezers and ensure your team are aware of and understand where exactly the written locations relate to and in what format you would like the exact locations of each sample recorded.

Lastly, tell the team a bit about the background to the collection as a whole and/or some of the curation units. By putting the collection into context you will help your team understand that the work they are doing is important and will ultimately enable you to better utilise the valuable resources you hold.

b Developing the data sheet

The initial inventory spreadsheet completed in the previous chapter should be organised by priority. Each individual curation unit will then require its own tab (suitably renamed), where the team will input data for the thorough sample-by-sample inventory. It helps if the tabs are ordered by priority with the highest to the right of the initial curation unit sort tab (see figure 3.2). That way the team can work through each tab completing the thorough inventory for each curation unit in turn.

Each curation unit tab will require an overview of the samples, including any notes on their format and whether there are any collections-care requirements. Also, include instructions on the conditions for handling (e.g. on ice or dry ice) and a detailed description of where the collection is located in the freezers. It can also be beneficial to take a photograph of the freezer before and after the curation unit has been sorted. See figure 3.2 for an example of how this data can be formatted per tab.

If the tubes are barcoded, be sure to provide your team with the equipment to easily scan (or bulk-scan) the tube and/or box barcodes into the spreadsheet. Additionally, if you manage your collection using a collections management system, such as EMu, Adlib, FreezerPro, Microsoft Access etc., include instructions for your team on how to update the records and/or create new records so that each curation unit can be updated on the system once completed.

Below the curation unit overview, include the fields that will be completed by you and/or your team (see figure 3.2). These will include: the auditor details, the location of the sample in the freezer, box details, tube details and fields describing any reformatting/relabelling conducted to fulfil any collections-care needs. See an example of the fields you may wish to include under each category, and how these fields may look in a spreadsheet, in figure 3.2.

You may find that there are unknown/unidentified collections/samples in amongst the freezers you are sorting. To log all unknown/unidentified collections/samples create a dedicated tab, we like to call this the *'Surprise Samples!'* tab (referred to in the thorough inventory workflow in figure 3.1). Add the date found, by whom it was found and use the same fields as per the known curation units (see figure 3.2) to enable your team to capture as much data about the unknown/unidentified samples as possible.

Curation Unit Overview

Curation Unit Name	Priority	Description	Number of Samples	Associated Data	Data Description	Metadata Location	Collection Location	Collection Current Format	Collection-care Needs	Handling Instructions	Contact Name	Contact Details	Freezer Photo Before	Freezer Photo After
Reptiles	1	Mostly DNA extracts of lizards from Africa and Snakes from Australia collected between 1980 to 1990.	Approx. 700	Yes - excel spreadsheets	collection date, collector, location and species	C:\Documents\ Collections Inventory\Reptiles	Basement, Freezer 5, drawers 1, 2, 3 and 4	2ml Eppendorf tubes in 81 well boxes. Approx 60 boxes	Barcode labels need to be added to each tube.	Wear gloves and handle samples on dry ice.	Joe Bloggs	joe.bloggs@email.com	Date: 2020_01_04 C:\Documents\ Inventories\ Reptiles	To be completed upon completion of the inventory.

Fields to be completed per sample:

	Auditors			Freezer Arrangement					Box Details					Tube Details							Collection-Care Details		
Counter	Inventory date	Sample handler	Scribe	Freezer Name	Shelf	Rack	Drawer	Box Position	Box label (top)	Box label (side)	Box Barcode	Box photo outside	Box photo inside	Well position	Tube label (top)	Tube label (side)	Tube barcode	Tube type	Sample type	Preservative	Reformatting Details	Reformatting Photo Before	Reforematting Photo After
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
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12																							
13																							
14																							
15																							
16																							

Initial Curation Unit Sort | Amphibians Inventory | Reptiles Inventory | Fish Inventory | Mammals Invent ...

Figure 3.2: The thorough inventory data collection sheet showing the curation unit tabs in order of priority (red to yellow). The focus here is specifically on the reptile curation unit tab and shows the summary information for the reptile curation unit at the top of the sheet (in blue) and the fields your team may be required to complete per sample below (divided into categories shown in black). An editable template of this data sheet is available through the CryoArks website.

Editable templates for the initial inventory and thorough inventory data collection sheets (as seen in figures 2.2, 2.3, 2.4, 3.2 and 3.3) are available on the CryoArks website.

The thorough inventory data collection template includes a full list of fields (with definitions) that may be relevant to complete per sample as well as an area for any abbreviations used to be outlined (see figure 3.3). Consistent use of abbreviations and a thorough understanding of the appropriate data to enter into each field is key for consistent data entry. This is especially true if multiple people or groups of people are working through the same collection at different times.

The thorough inventory template also includes a tab for '*process notes*' (see figure 3.3) which we strongly encourage those working on the inventory to complete. It is a free text tab to record details and notes on how the team has worked through the collection. Notes on the process followed can be extremely helpful for others to continue the inventory and/or reproduce it in future.

If working directly from the spreadsheet, be sure to include instructions for backing up the data. This is extremely important to do at regular intervals. We recommend backing up to a cloud storage (or other suitable) space twice a day (at lunch and at the end of the day). Backing up in a storage space, such as Dropbox or similar, allows for effective version control and for the datasheet to be downloaded onto and worked on locally from any laptop.

Alternatively, if consistent internet access can be guaranteed, creating the inventory in Google Sheets (or similar) will enable it to be updated by anyone with access and it will be automatically saved in real time. You could even have multiple teams working on different collection units and updating different tabs within the same Google Sheet simultaneously.

Once the data sheet has been updated and all instructions for your team have been included, they can begin sorting through the freezers!

Category	Field headings	Description	Abbreviations (if used)
	Counter	Countto keep track of the number of samples	
Auditors	*Inventory date*	Date of the sample audit YYYY_MM_DD	
	Sample handler	Name of sample handler	
	Scribe	Name of scribe	
Freezer Arrangement	*Freezer Name*	Freezer name/identifier	
	Freezer Shelf	Shelf number counting from top to bottom	
	Freezer Rack	Rack number counting from left to right	
	Freezer Drawer	Drawer number counting from top to bottom	
	Freezer Box Position	Box position counting from the back	
Box Details	*Box label (top)*	Transcription of the labelling on the top of the box	
	Box label (side)	Transcription of the labelling on the side of the box (Indicate which)	
	Box barcode	Box barcode	
	Box photo outside	Take a photograph of the outside of the box, any labels must be clearly in focus	
	Box photo inside	Take a photograph of the inside of the box, tube arrangement must be clearly in focus	
Tube Details	*Well position*	Well position formatted Rows / Columns e.g. A / 1	
	Tube label (top)	Labelling on top of tube. Leave blank if no labelling.	
	Tube label (side)	Labelling on side of tube. Leave blank if no labelling.	
	Tube barcode	tube barcode given to the tube as the audit is being conducted	
	Tube type	The type of tube the sample is housed in including volume (in ml)	FT = fliptop; SC = screwcap; CV = cryovial
	Sample type	Type of sample e.g. tissue, swab, DNA.	
	Preservative	Any preservative present. (if substance is known)	PF = plain frozen; RL = RNAlater; XXETOH = XX% Ethanol
Collection Care Details	*Reformatting Details*	Decribe the reformatting, reorganising or relabelling that occurred.	
	Reformatting Photo Before	Take a photograph of the sample before the collections care needs were addressed.	
	Reformatting Photo After	Take a photograph of the sample after the collections care needs were addressed.	
	Notes/comments	Any specific notes to mention. Free text field. Be as detailed as possible.	

Thorough Unit Inventory | Field Descriptions | Process Notes

Figure 3.3: The thorough inventory data collection template available on the CryoArks website includes the data entry tab (see figure 3.2) in red, a full list of fields with definitions as seen in this figure and a free text tab in purple for notes on the process followed when conducting the inventory.

c Sorting through the freezers - one curation unit at a time

The team should work in groups of at least two people and take regular breaks, especially if working in cold conditions in the freezer/liquid nitrogen room. Begin with the curation unit identified as the highest priority in the initial inventory and have the relevant curation unit thorough inventory spreadsheet accessible and editable. The team should start by verifying the location of the curation unit as a whole, updating the inventory if any samples are not where they are expected to be, or extends over more locations (e.g. drawers within a freezer) than expected.

The team will ideally need two tables/trolleys, one to set up the laptop and another to work with the samples. Therefore, one person will act as the scribe, inputting the data as it is read out by at least one person handling the samples. Record the data directly onto the spreadsheet if possible and be sure to make a note of all available information associated with the samples. Systematically work through the samples one box at a time, completing all fields in the curation unit tab as thoroughly as possible (see figure 3.2).

Your team should, transcribe any information on the box into the relevant fields and scan the box barcode if present. Next, check each sample one at a time, scan the barcode if present and transcribe any written information on the tube. We recommend making a note of the location of the tube in the box in the following format; if the wells are marked, note the row character then column character separated by "/" (e.g. if the rows are marked by letters and the columns by numbers, a sample in the first well of the box would have the coordinate A / 1, see figure 3.4).

If the wells of the box are not marked and it has a hinged lid, orientate the box so that it opens away from you with the latch at the front and hinge at the back. The first well is the back left and is recorded as row A / column 1 (see figure 3.4). The row letters will be sequential counting from the back forwards and the columns will increase by number counting from left to right.

Be sure to make a note of the orientation of the box and the well-coordinate system in the notes section. If the box has no well markings and a lid with no hinge, write on the box to indicate the front and back and use the same column and row numbering as a hinged box (as in figure 3.4).

It can be helpful to take a photograph of the box, instead of, or as well as writing a description. The images show the box format, orientation and tube arrangement and can be a very helpful visual reference for the tube locations. The image can be embedded into the spreadsheet, or a hyperlink to the image file in a folder can be added to the box details fields.

Your team may also find it easier to write the tube locations into a printed diagram of the box arrangement. This can also be scanned and embedded or added to the spreadsheet as a hyperlink. It can help avoid typing errors, however any written records run the risk of errors when interpreting handwriting. To minimise this we suggest agreeing a convention for writing letters and numbers.

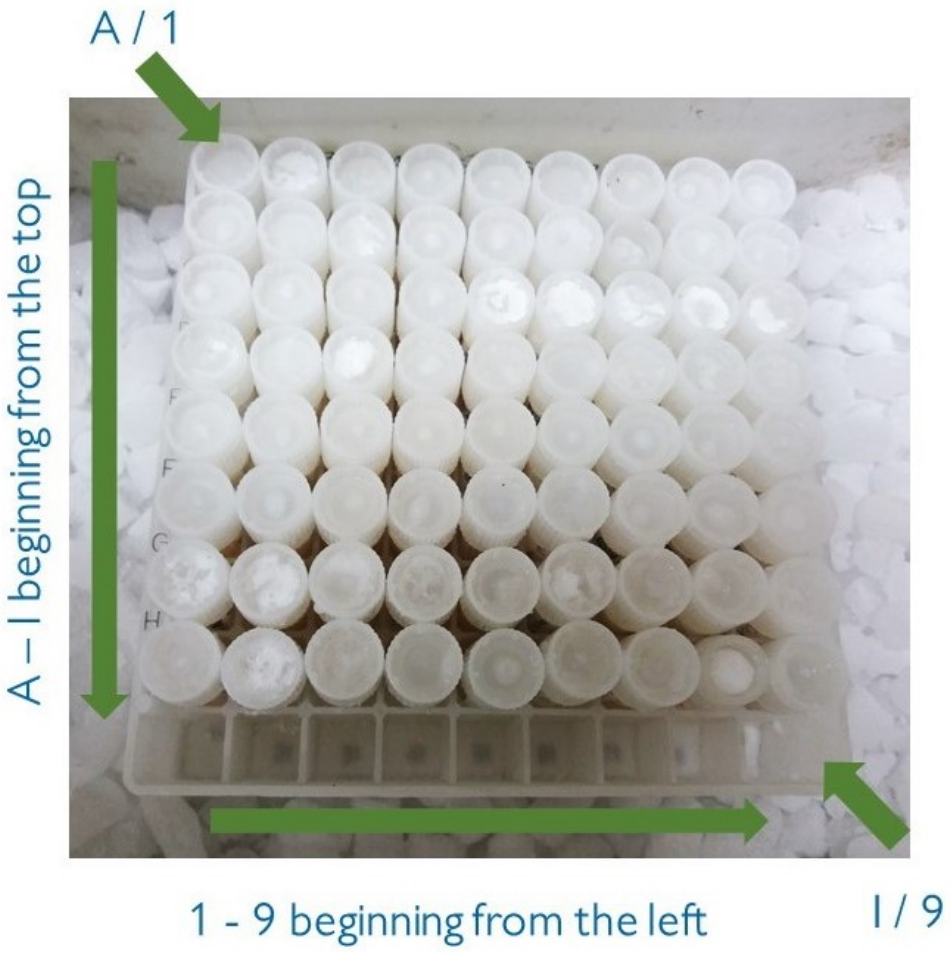

Figure 3.4: A tube box with the column and row numbering system displayed.

When writing the location of the box in an upright freezer, begin with the freezer name and record the shelf counting down from the top beginning at 1. Write the rack number counting from left to right beginning with 1. If the rack has multiple drawers, count down from the top beginning at 1. When pulling out a drawer and recording the position of the box within it, count from the rear forwards, beginning from 1.

If there are stacked boxes in the same position within a rack, count the top box and then the lower box sequentially. See image 3.5 of a large upright freezer with the shelves, racks, drawers and the box position marked for reference. A box located in a liquid nitrogen tank can be recorded in a similar way. The rack number or barcode indicates in which rack in the tank the box is located, then count down from the top of the rack to indicate the position of the box in the rack.

If samples are in a chest freezer, begin by compartmentalizing the space (e.g. left-hand side, centre or right-hand side). If the boxes are racked within the chest freezer, note the rack number and box position in the rack. If the box is stored with others in a larger container, describe it in detail. If the samples are not in a box, but are loose in a bag or other unsuitable container, reformat them and record the new locations, making a note of the change in the collections-care fields.

Additionally, as you are moving through the freezers, record if any spaces are empty (e.g. if an entire rack/shelf/drawer remains empty). This information is extremely helpful for the collection manager to better utilise limited space. When working, minimise the time that the freezer door is open and ensure it is properly closed in between accessing the boxes. Lastly, don't forget to back up the data file at lunch and at the end of the day!

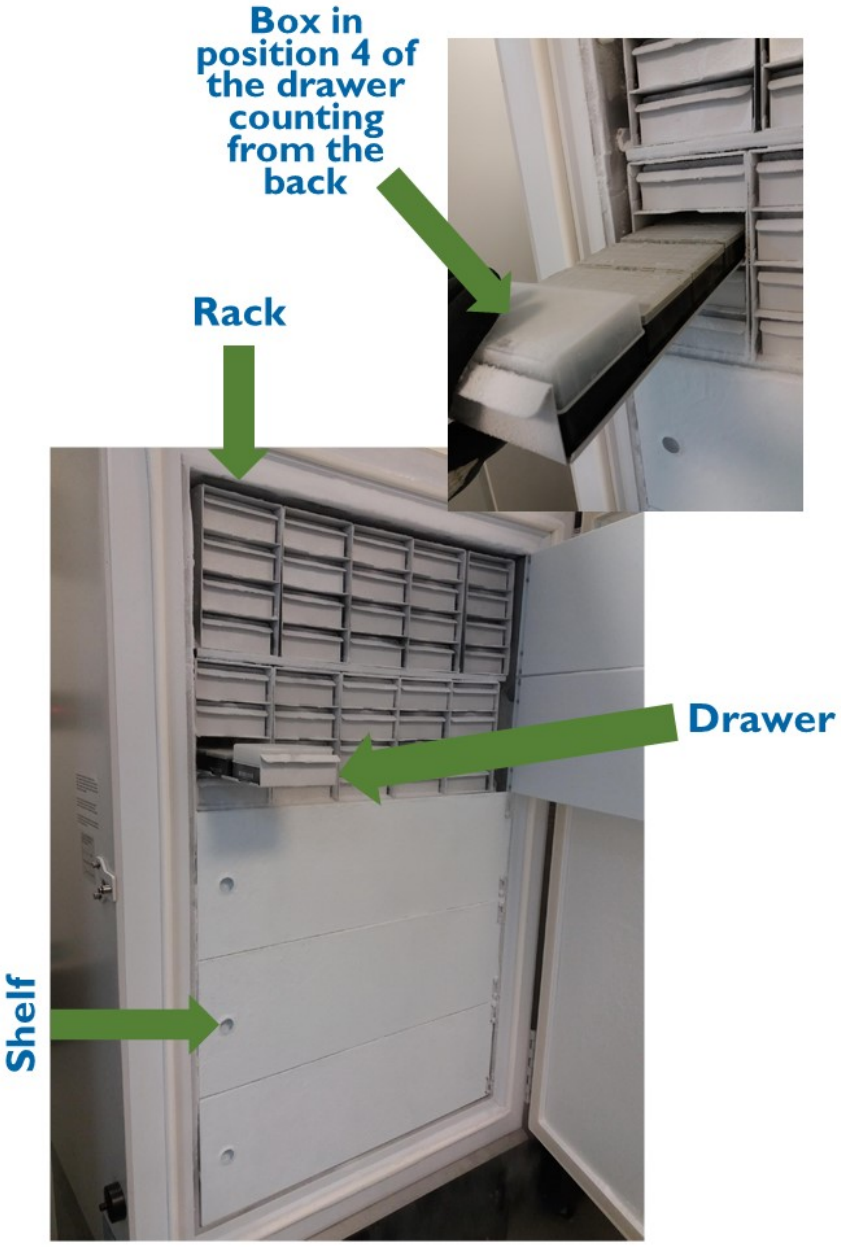

Figure 3.5: The arrangement of drawers, shelves and racks in a large upright -80°C freezer.

d Reformatting, reorganising and relabelling

If any collections-care needs have been identified in the initial inventory then be sure to have all resources ready and available when conducting the thorough sort. Make a note of any reformatting that is carried out in the appropriate columns of the curation unit tab (see figure 3.2).

It may be necessary to thaw and transfer the samples into new tubes if the current vials are unsuitable, e.g. if a vial is damaged, the vial is too big for the size of the sample, the samples are not housed in vials that can withstand long-term storage at low temperature or the samples aren't actually in vials at all. But do try to avoid this if possible (see figure 3.6 for examples of good and bad collections storage conditions).

If adding an adhesive label to the sample, only use those designed for the temperatures at which the samples will be stored. Adhesive labels that are able to stick onto frozen tubes are now available from a number of suppliers. We recommend considering these to reduce the need to thaw the sample. When relabelling try to avoid covering any information written on the tubes or the box.

Where possible when relabelling, include a barcode (either 2D or matrix). Barcodes enable you to have a unique identifier per sample, which can be used to link a sample to its associated data. Barcodes are also used by both CryoArks hubs and will aid in sample transfer should the collection be moved to us.

If you are able to reorganise the collection to maximise the space as you are sorting, input the new location in the location fields of the collection unit tab and note the previous location in the relevant collections-care field. As you are sorting, make a note of anything that is damaged or not labelled. Log information about any unknown/unidentified collections/samples in the *'Surprise Samples'* tab as they are found. Input as much data about any unknown/unidentified samples as possible to aid in cross-matching with the metadata at a later stage (see the last stage of the thorough inventory workflow in figure 3.1).

If you are at all unsure of whether to include any information in a spreadsheet, add it to the notes field. It is best to collect more information than less. Any anecdotal observations/comments may be important when planning collections-care activities, when working out how to maximise the use of space and/or in making decisions on whether to retain/discard samples.

Figure 3.6: Examples of unsorted curation units (some in unsuitable containers and tubes) on the left. On the right are examples of sorted curation units in appropriate tubes, boxes and racking.

e Cross-matching with existing data

Ensure that your team has access to the metadata for each curation unit gathered in the initial inventory. Once they have completely sorted through the samples that belong to a single curation unit, cross-match the inventory with any existing metadata that you have for those samples.

Ideally, from the transcription of the labels on the box and tubes, as well as the tube locations, you should be able to match the samples with the records in the metadata. In this instance, amalgamate the data sheets either by copying and pasting the metadata to the inventory (or vice-versa), or by copying both sets of data into the same row in a new master worksheet (this is what we would recommend so you always have a working master worksheet, but the original data and inventory are unchanged and can be referred back to).

You may wish to use the CryoArks data template as your master worksheet to amalgamate your data. This can be accessed via the CryoArks website. The template is appropriate for museum, university and zoo collections as only relevant fields are revealed based on your institution type. Our template was developed based on the EMu data management system structure, primarily using Darwin Core terms and with the input from the zoo, academic and museum communities, it includes sections on all major data categories. The template and instructions for its completion can be found on the CryoArks website resources page.

Matching the metadata with the samples may not always be possible. You may find that there are data representing samples that were not present in your inventory. If this is the case, cross-check these records with any unknown/unidentified samples that you came across and recorded in the '*Surprise Samples*' tab (detailed above). If there is still no match, copy this to a sub-list of samples not yet found and continue to cross-check with any new unknown/unidentified samples you find in other locations.

If by the end of the sort you have data for records that don't match any samples in your curation unit inventories, or your tab of '*Surprise Samples*', then you can safely assume that the sample no longer exists in your collection. These records should not be discarded, but kept on their own tab/worksheet of '*Lost Samples*', just in case they turn up somewhere else, or have been on loan elsewhere.

Similarly, you may have found samples (or even collections) that do not match any existing data. A sample with no data is severely limited in its potential uses. If that sample has any data on the tube or box relating to its taxonomic identification, then there may be an argument for retaining the sample without any further associated data, should it be from a particular taxonomic group of interest (e.g. from a rare animal, or from one of the CryoArks priority groups identified in our gap analysis). However, if the samples/collection have no data at all (either on the tube, on the box, on paper, or digitally) and cannot be matched with any existing metadata, then you may wish to discard the sample to free up space for more valuable (and data-rich) samples/collections.

f The protocol in brief

In this section we have produced a step-by-step overview of the thorough inventory workflow, which your team can refer to as they are working. It is assumed that you have completed the initial collection unit inventory and have prepared the data sheet for your team to begin the thorough inventory.

Conduct a thorough inventory step-by-step

One person should input the data, while another handles the samples. Systematically work through the samples, be sure to note all available information and complete all fields as thoroughly as you can. Minimise the time that the freezer door is open and ensure it is properly closed in between accessing the boxes.

Stage 1) Sort through the freezers

1. Start with the highest priority collection unit
    - Conduct a thorough inventory of each collection unit in order of priority. Complete the steps in stages 1 and 2 for each collection unit before moving on to the next.
2. Add the location of the box in the freezer
    - In an upright freezer, record the freezer name, the shelf (counting from the top), the rack (counting from left to right) and the drawer (counting from the top).
    - Count the box position from the back of the drawer. If there are stacked boxes, count the top then the lower ones sequentially.
    - A box in a liquid nitrogen tank can be located by the rack identifier, then count from the top of the rack down to the box position.
    - In a chest freezer compartmentalise the space (e.g. left-hand side, centre or right-hand side). If the box is stored with others in a larger container, describe it in detail (and take a photograph for reference).
3. Transcribe the box label and/or scan the box barcode
    - Transcribe any information on the box into the relevant fields and/or scan the box barcode if present.
4. Add the location of the tube in the box
    - If the wells are marked, record the row character then the column character separated by "/".
    - If the wells are not marked but the box has a hinged lid, orientate with the latch at the front and hinge at the back. The first well is the back left (row A / column 1). Count the row letters from the back forward and the column numbers from left to right.

- If the box has no well markings and a lid with no hinge, write on the box to indicate the front and number as above.
- (Optional) Make a diagram of the box arrangement and write the tube identifier in the corresponding position.
- (Optional) Take a photograph showing the tube arrangement.

5. Transcribe the tube label and/or scan the tube barcode

    - Check each sample one at a time, scan the barcode if present and transcribe any written information on the tube (cap and side) into the relevant fields.

6. Reformat/relabel and describe the actions taken

    - If the samples are not in a box but are loose in a bag or other unsuitable container, move them into appropriate containers and record the new locations. Make a note of the previous condition/location in the reformatting details field.
    - When relabelling, try to avoid covering any information written on the tubes or the box.
    - If you are able to reorganise the collection to maximise the space as you are sorting, input the new locations in the location fields and note the previous locations in the reformatting details field.

7. Add any and all other information to the notes field

    - Record if there is any empty space in the freezer.
    - Make a note of anything that is damaged or not labelled.
    - Log all unknown/unidentified collections/samples in the '*Surprise Samples*' tab. Be sure to include the date found, by whom it was found and input as much data about the unknown samples as possible.
    - If you are unsure whether to include any information, add it to notes.

8. Upload images, scan any hand-written notes and **back-up the file**

    - Scan hand-written notes and upload images files to the relevant folder, relabelling them appropriately.
    - Add the hyperlink/location of each file to the relevant fields.
    - Don't forget to back-up the data at lunch and at the end of the day!

Stage 2) Cross-check the inventory with the metadata

1. Match the sample with the metadata

    - From the transcriptions of the labels on the box, the tube labels and the tube locations you will be able to match the samples with the corresponding metadata.
    - It can be helpful to use the 'find' function to search for keywords.
    - Check that all fields from your inventory are consistent with the metadata, before confirming it's a match.

2. Consolidate the inventory and metadata

    - Copy and paste the metadata and the inventory data for each matched sample to the master worksheet for that curation unit.
    - Add the sample inventory data you were unable to match to any existing metadata to the '*Surprise Samples*' list. Make a note that the data had been checked against a particular dataset.

3. Check any unmatched records against the *Surprise Samples* list

    - If there are data representing samples that were not present in your inventory, cross-check these with any unknown/unidentified samples in your '*Surprise Samples*' tab.
    - If there are still no matches, copy these to a sub-list of samples not yet found and continue to cross-check with any new *Surprise Samples* you find in any other locations.

How CryoArks can help

If you are reading this document, you may have already visited the CryoArks website, where in addition to the wealth of information and available resources, you will see that we offer advice, guidance and training.

a What information would CryoArks need?

We appreciate that not everyone will be able to assemble a complete inventory of what is in their freezers. You may be sorting through a collection you have put together over the duration of your career, or be dealing with a collection that you are newly responsible for. You may be starting out with spreadsheets of metadata, or having to gather together field notes, or even post-it notes. Regardless of how thoroughly you are able to complete your inventory, we would like to see as much data as you are able to amass.

The more information we have on your collection, the better we will be able to advise you, assess the needs of the collection and evaluate whether the taxonomic representation of your collection fits in with our sample collection strategy and priorities. Every collection is different and we realise that it can seem like a very daunting task, but we hope that the information provided in this document has helped you to get started.

b The support we can offer

We are able to provide advice on how to conduct an inventory, discuss the resources you might need for reformatting/relabelling and recommend ways in which you may be able to enhance your data management. Please first visit the CryoArks website for information on these topics and contact us if you would like to discuss your situation in more detail.

Unfortunately, we do not have the staff or the resources to come to your institution and conduct the inventory for you (as much as we might like to). However, we can do a site visit to advise you on how best to go about an inventory, what collection needs you might encounter and/or what curation units you might want to prioritise based on the CryoArks UK collections taxonomic gap analysis.

It may also be possible to conduct a joint volunteer project. We would be able to assist with recruitment and the volunteers would visit one of the CryoArks hubs for in-house training on how to conduct a thorough inventory (subject to expenses covered by the local institution). A CryoArks staff member would also come out to conduct on-site training and provide advice to get the volunteers started with the inventory at your institution.

A thorough inventory is very beneficial because it would enable you to make appropriate decisions about the samples you hold. It would also help you to assess whether you wish for the collections to be made discoverable by uploading the data to the CryoArks Specify Database, thus making them available to the wider research community.

Secondly, the thorough inventory will help us assess how the taxonomic representation of your collection fits with the CryoArks priorities. You may wish to move all/parts of the collection, or move duplicate samples to create a back-up collection at one of the CryoArks hubs. For further information please visit the CryoArks website and/or see the next section for how to get in touch!

c How to get in touch

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