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| **COMMON ELEMENTS**  **IN OTHER DATA SYSTEMS**  *e.g. CMS, SPREC, LIMS* | **ELEMENT**  **CODES**  *Used to identify and prioritize (Tier 1, 2, 3)**BRISQ items* | **REPORTING DATA FOR CREATING A GENERIC BIODIVERSITY BRISQ**  Quick reference reporting check (√) list for main elements in **bold** | **EXAMPLES OF BRISQ ELEMENTS FOR BIODIVERSITY SAMPLES MAINTAINED IN REPRESENTATIVE**  **TYPES OF NON-VIABLE (MUSEUM) AND VIABLE (CULTURE) COLLECTIONS** | |
| **MUSEUM COLLECTIONS** | **CULTURE COLLECTIONS** |
| *1Accession-strain identifier or unique curatorial ID* | |
| **I. PRE-ACQUISITION - ASSOCIATED SAMPLE DATA** | |
| CMS  LIMS | **I.a** | **Type of institution**  *Institution/organization type and primary context in which the biospecimens, samples or organisms are acquired, exchanged, donated, on loan or accrued.* | (a) part of an internal collection; (b) from another biorepository, biobank, collection, including on loan samples; (c) provided by research networks, consortia, infrastructures; (d) a new acquisition; (e) accrued via a specific project (e.g. EU or wider international programme). Associated data: correct 2curatorial code for internal collections; primary contact details for external collections, consortia, projects. Verification of guidelines, best practices, SOPs used, indicating if they are available on request by others (*see I.f).* | |
|  | **I.b** | **Selection criteria (sample)**  *Scientific, research and usability criteria* *used to inform, choice of biospecimen, organism for preservation and/or conservation.* | *Ex situ* conservation, habitat restoration, re-introductions, genetic resource, endangered, at risk species management, biodiversity and taxonomic research, climate change and environmental research. Collections of Type specimens, strains, vouchers, environmental indicators, reference strains, eDNA, metagenomics. | *Ex situ* conservation, habitat restoration, re-introductions, genetic or biotechnological resource, endangered, at risk species management climate change, environmental, biodiversity, taxonomic , eDNA, research. Bioresources: Type cultures, strains, environmental indicators, reference strains, bioremediation, toxicology; omics research; bioprospecting: foods, pharmaceuticals, nutraceuticals, cosmetics. |
|  | **I. c** | **Selection criteria (quality)**  *Sample quality standards for acceptance and rejection criteria.* | Primary quality and data standards (e.g. authenticity, stability, purity) used to decide whether a sample, biospecimen, organism is of an appropriate quality to place in a collection. Selection based on: end user needs, intended, future use, rarity, multiple qualitative (dead or viable) and quantitative (% viability) standards. Also see I.b, I.f. | |
| CMS  LIMS  SPREC | **I.d** | **Collection modality**  Preservation or conservation*,*  *Both modes can occur within an institution.* | Preservation of non-viable biospecimens in frozen, desiccated, fixed, pinned, spirit (IMS, absolute ethanol, formaldehyde, formalin, molecular (RNALater) collections. | Conservation of viable non-replicable and viable / replicable cultures and germplasm maintained in working, active, base, master collections. |
| *CMS, LIMS*  *SPREC* | **I.e** | **Collection category**  Biospecimen, sample, biological resource, genetic resource, Type, reference, voucher. | Flora, fauna, paleontological samples: DNA, RNA, blood, serum, urine, horn, hair, fur, feather, bones, cells, tissues, organs, wood, seed, pollen, whole organisms, herbarium reference, Type, voucher biospecimens. | Explant, cells, tissues, organs, propagules, DNA, RNA, replicable organisms, gametes, embryos, seeds, pollen, spores, cysts, somatic cells, clonal propagules, Type cultures, reference strains. |
| *CMS, LIMS* | **3I.f** | **2Provenance**  *Documented authentication.* | **2I.f.1 History of Ownership.** Formal documented evidence providing historical context of ownership. Legal provenance records used for specimen authentication in archival inventories demonstrating chronological, traceable chains of custody as sequences of formal ownership (e.g. transfer of title), including location/storage attached to primary samples, all derivatives and downstream processing requests. Compliant with International conventions (CBD, Nagoya Protocol ABS, CITES) and permits for collecting the specified species in the specified area, and MTA agreements to share, utilise/analyse the specimens collected with the country of origin.  **21.f.2 Place of Origin.** Place of origin and/or sample site (including GPS) of strains, isolates, propagules, plants, explants, seeds, organisms that are used to generate culture collections that comprise expertly preserved, authenticated viable cell lines, replicable cultures, microbial strains or whole organisms of known provenance (origin). GPS location of the collection site, descriptive details of habitat, ecological zone e.g. marine, freshwater aquatic, water chemistry; terrestrial e.g. soil type, vegetation type; substrate e.g. lithosphere, cryosphere. Habitat attributes: geological geographical features, topography, slope, depth, altitude, sedimentary, eDNA, soil. | |
| *CMS, LIMS* | **I.g** | **Time scale**  *Collection timelines* | Geological timescales (GTS). Deep time denoted as epochs with distinctive features (stratigraphy) used by geologists, palaeontologists, to record the Earth’s history as timelines depicting specific events. Epoch (10s millions of years); ancient (millennia), archival (centuries), vintage (decades). | Present time to biopreservation timescales (days - multiple decades) representing storage regimes. Medium term storage (MTS - months 1 - 2 years) in expansion, distribution, working, and active collections; long-term storage; (LTS - multiple decades) in base or master collections (cryobanks – *ad infinitum*). |
| *CMS, LIMS* | **I.h** | **Taxonomy**  *Taxa - species conserved.* | All kingdoms represented, identified to species, sub-species; taxonomic identifier authenticated by taxonomic ID guarantee, see VII.b, metagenomics, eDNA. | Individual or groups of taxa representing thematic (microbial, protist, plant, animal) or functional, socioeconomic (crops, pathogens, yeasts, forestry, environmental) collections., identified to species, sub-species; strain, cultivar, genotype level as appropriate. |
| *CMS, LIMS* | **I.i** | **Biological donor**  *Donor of original sample, specimen.* | Individual organism, historical or ancient specimens, present time, fresh. | Multiple or individual donors from specific or multiple taxa, associated species/organisms, parasites, symbionts, assemblages. Sub samples collected from *in situ* populations. |
| *CMS, LIMS* | **I.j** | **Anatomical site**  *Organ or tissue of origin of sample.* | Any anatomical part (bone, muscle, hair, horn) of an organism from where biospecimen, or sample is collected, usually non-viable and non-replicable. | Cells, tissues, organs, spores, clonal propagule, totipotent germplasm (gametes, ova, pollen, sperm, oocytes, eggs), explant, seed, zygotic embryo, embryonic axis, shoot meristem, hyphae, mucilaginous matt, symbiotic or parasitic assemblage. |
| *CMS, LIMS* | **I.k** | **Vital state**  *Viable or non-viable* | Usually non-viable, mainly collected post mortem. Details of agonal state (physical condition immediately preceding death) and cause of death important for certain biospecimens (e.g. wildlife forensics, toxicology, epidemiology studies). | Viable. |
|  | **I.l** | **Physiological & developmental state**  *Functional status - morphogenetic, growth, developmental competence, totipotency.* | Non-viable, replicable (DNA) from dead cells. | Viable/non-culturable or viable/culturable; autotrophic, heterotrophic, mixotrophic, log, lag, stationary culture, sporulating, meristematic, totipotent i.e. capacity to regenerate whole new cells, organs, organism. Morphogenetically and biosynthetically (1˚ - 2˚ metabolism) competent. |
| *CMS, LIMS* | **I.m** | **Gender** | Male, female, hermaphrodite. | |
|  | **I.n** | **Life cycle & reproductive state**  *Stage in life cycle when sample was taken from organism or functional part (seed, fruit, pollen, embryo) of organism.* | Juvenile, mature, quiescent, ageing, senescent; sexual or asexual; life cycle stage: gametophyte (haploid), sporophyte (diploid); clonal propagule (e.g. bulb, corm, tuber); sexual hybrid (e.g. mature/immature seed, ripe/unripe fruit). | |
|  | **I.o** | **Health and nutritional status**  *Healthy or sub-optimal condition.* | Healthy or damaged , injured, traumatized, stressed (biotic , abiotic), nutrition optimum or nutritionally compromised. | |
|  | **I.p** | **Toxicology status**  *xenobiotic exposure.* | No exposure, or exposed to pollutants, toxins, poisons, xenobiotics, radiation. | |
| *CMS* | **I.q** | **Axenicity**  *Axenic - free from other organisms.* | Axenic or non-axenic e.g. systemic, covert, endogenous co-contaminants, symbiotic partnerships, mycorrhizae, obligate /non-obligate parasitic associations (see Disease and Pathology Status I.q). | |
|  | **I.r** | **Disease & pathology status**  *Diagnostic test outcomes required for epidemiology and risk management.* | Disease free state confirmed; presence of parasites, pests, poxes test-confirmed. | Disease-free or infected with pathogens, mycoplasmas, phytoplasmas, viruses, retroviruses, bacteria, yeast, fungi, pests; test-confirmed as a pathological positive test or certified healthy, pathogen, virus, pest-free. |
|  |  | **II. ACQUISITION, STABILIZATION & TRANSPORT** | | |
| *CMS, LIMS*  *SPREC* | **II. a** | **Collection & sample container**  *How samples are obtained from field site, conditions to which exposed.* | Polyethylene bottle/bag/tube, glass tube, jar, sterile bottle, Petri dish, cryovial. Sterile scalpel, small muscle section, multiple others. | Polyethylene bottle/bag/tube, glass tube, jar, sterile bottle, Petri dish, cryovial Aspiration, plankton net, *In vitro* field collection, climbing tree, ground, soil, water, snow, litho sampling. |
| *LIMS*  *SPREC* | **II.b** | **Time**  *From collection to stabilization.* | Minutes, hours, days, months, years. | Minutes, hours, days, months. |
| *CMS, LIMS*  *SPREC* | **II.c** | **Stabilization**  *How samples are stabilized during and immediately after collection from the field.* | CRF, buffer on wet ice, + multiple others. Humane euthanasia using chemicals and drugs under licensed procedures e.g. Insects: killing jar with alcohol or ethyl acetate; fish/amphibians: tricaine methanesulphonate, benzocaine hydrochloride, 2-phenoxyethanol. Snap freezing in LN2/dry shipper. | Temperature ambient, refrigerated, on ice, in LN (Dry Shipper); ± low RH dried, desiccated (air, chemical desiccant, silica gel) to a specific MC (e.g. 5 - 15% fresh weight); disinfection, antifungal, antimicrobial treatments; dark, light, low light, photoperiod. |
| *SPREC* | **II.d** | **Shipping parameters stage 1**  Transport container and conditions**,** time in transit before interim storage  *Shipment from remote location.* | Ambient or controlled temperatures, Dry LN shipper; dry ice, desiccant, silica gel; minutes, hours, days, months, years. Log of environmental conditions (T˚C, RH, light). | Ambient, controlled environment facility or container; minutes, hours, days, months. Log of environmental conditions (T˚C, RH, light). |
| *SPREC* | **II.e** | **Interim storage**  Storage container, duration, RH; temperature, light  *Storage at field station.* | Glass tube, jar, bag, cryovials; minutes, hours, days, months;; ambient, low temperatures: 4°C, -20°C, -80°C; 80%; RH <40% with silica gel; light, dark, diffuse | Polyethylene bottle/bag, glass tube, jar, sterile bottle, Petri dish cryovials; minutes, hours, days, months, ambient, low temperatures 4°C, -20°C, -80°C, RH: 80%, 15%; light, dark, diffuse, photoperiod. |
| *SPREC* | **II.f** | **Shipping parameters stage 2**  Transport container and conditions**,** time in transit before interim storage  *Shipment from remote location.* | Ambient or controlled temperatures, Dry LN shipper; dry ice, desiccant, silica gel; minutes, hours, days, months, years. Log of environmental conditions (T˚C, RH, light). | Ambient, controlled environment facility or container; minutes, hours, days, months. Log of environmental conditions (T˚C, RH, light). |
| *SPREC* | **II.g** | **Short-term storage**  Storage container, duration, RH  temperature, minimal growth. *Storage of sample at main biorepository.* | Glass tube, jar, bag, cryovials, mins, hours, days, weeks, glass tube, jar, bag.  ambient, controlled, 25°C, 4°C, -20°C, -80°C.  80%, <40% with silica gel. limiting growth conditions N/A for non-viable collections. | Glass tube, jar, bag, cryovials; mins days, weeks, months; ambient, 25°C, 4°C, -20°C, -80°C, LN.  80%, 15%; minimal nutrients, light, growth factors, T˚C |
|  |  | **III. PRESERVATION, FIXATION & STORAGE** | | |
| *CMS*  *LIMS* | **III.a** | **Preparation**  Procedures used to prepare and prevent sample deterioration before storage; duration of exposure to treatments *Chemical preservatives prevent degradation by pests, microorganisms, limit chemical reactions oxidation, hydrolysis, physical treatments arrest biological activity and eliminate pests.* | Multiple preparations. Organisms or biospecimens prepared in IMS, 80% (v/v) ethanol; molecular collections prepared in absolute ethanol, RNALater, DMSO/NaCl buffers. Low temperature pre-treatments ( -20˚C) dehydration, low RH evaporative desiccation (silica gel), freeze drying, inert atmospheres, low O2. Treatment exposure times, minutes, hours, days, weeks. | *N/A for viable, replicable collections.*  *see section IV, V.* |
| CMS | **III.b** | **Chemical fixation**  Process by which biospecimens are ‘fixed’ to preserve them as close as possible to original state*. Altering biochemical state to preserve the physical form.* | Multiple procedures. Zoological spirit collections: formalin/formaldehyde fixation, transferred to spirit; tissue slices: FFPE slide preparations; chemical dehydration using glutaraldehyde fixation; CPD for SEM samples and pinned insects; fresh cells lysed and DNA fixed on a paper matrix by chemicals in FTA cards. | *N/A for viable, replicable collections.*  *see section IV, V.* |
| LIMS | **III.c** | **Preservation by desiccation and drying**  *Reducing sample MC to preserve original structures, morphological attributes before storage* | Chemical dehydration CPD for SEM /pinned insects; herbarium plant mounting freezing at -30 ˚C for 1 week, dehydration in drying room (days), mounted on acid free paper in plant presses. | *N/A for viable, replicable collections.*  *see section IV, V.* |
| *CMS, LIMS* | **III.d** | **Flash / snap freezing**  *Ultra rapid cooling to fix the biomolecular state of the original sample before transferring to terminal storage temperatures.* | Plunge whole specimen or sub-sampled tissue from non-viable specimen into liquid LN or vapour phase LN in dry shipper. | Some viable orthodox seeds, pollen, spores, cysts, dormant buds, extremophile microorganisms can be preserved using ultra rapid cooling without the need for cryoprotection and recovered in the viable state after storage see section V. |
|  | **III.e** | **Preservation at low temperatures**  Methods used to preserve non-viable samples at low and ultra low (cryogenic temperatures). | Multiple methods. Preserved using water or buffers, with or without protective additives applied at various temperatures, exposure times, cooling rates. | *N/A for viable collections see section Va, Vb* |
| SPREC | **III.f** | **Long-term storage**  *Conditions in which (usually) non-viable specimens are permanently stored in ambient , or environmentally controlled conditions or at low and ultra low temperatures.* | Multiple types of storage. Storage vessel, sample container (e.g. cryovials, cryotank). Long-term storage of biospecimens, organs, organisms in IMS spirit collections at 15˚C < flash point of ethanol; plant material stored at RT with desiccant, traditional dry stores: ambient, 40 % RH (optimal), molecular collections stored at ambient temperatures , various RH (+ with silica gel); FTA card, freeze dried material stored in RH and O2 controlled cabinets; frozen collections stored at 4˚C, -20˚C, -80˚C, -196˚C, LN vapour. | *Some (e.g. orthodox seeds, pollen, spores, cysts, dormant buds, extremophile microorganisms) viable cells, tissues, organs, organisms can be stored at low MC at ambient or low temperatures without the need for cryoprotection and recovered in the viable state after storage.*  *see section IV, V.* |
|  | **III.g** | **Freeze/thaw Parameters/cycles**  *Conditions to which specimens are exposed when thawed; number of freeze/thaw cycles.* | Multiple types of freeze/thaw conditions slow, rapid, stepwise rewarming, temperatures, times at which specimens are held between thawing an analysis and re-freezing. Number of freeze/thaw cycles. | *N/A for viable collections see section Va, Vb* |
|  |  | **IV. *IN VITRO* CULTURE** | | |
| *LIMS*  *SPREC* | **IV.a** | **Culture**  Isolation, disinfection, anti-microbial treatments, culture vessel, culture initiation, propagation, cultivation  subculture, serial culture, serial passage, regrowth, regeneration  Controlled environment parameters.  *Procedures involved in the initiation, maintenance, (sub-culture, serial culture) regrowth, regeneration, transfer of replicable cultures.* | N/A for non-viable museum collections. | Aseptic, *in vitro*, microbiological techniques for the sampling and isolation of microorganisms, protists, explants, animal cells; antimicrobials (disinfectants, bleach, hypochlorite solutions, surfactants, antibiotics, fungicides, miticides).  Culture vessel (size, type, sealant, ventilation). Media composition (macronutrients, micronutrients, gelling agents, hormones, vitamins, growth regulators, carbon source, antioxidants, special additives, pH) for culture initiation, proliferation, subculture and transfer regimes (to stimulate morphogenesis, regeneration or return to *ex vitro* growth).  RH, T˚C, light intensity, irradiance, quality, photoperiod (dark, light, diurnal) environmentally-controlled (light, T˚C, O2, CO2) regimes applied to simulate *in vitro* and natural life cycles (growth, clonal propagation, morphogenesis, embryogenesis, dormancy, rejuvenation, acclimation). |
|  |  | **V. CONSERVATION, STORAGE & RECOVERY** | | |
| *LIMS*  *SPREC* | **V.a** | ***In vitro* conservation**  culture vessel, duration, temperature, RH, growth limiting conditions, sub-culture, serial culture regimes (transfer intervals)  *Procedures used to maintain viable active culture collections in serial culture or slow (arrested, limited) growth**( medium-term storage.* | N/A for non-viable museum collections. | Petri dish, glass jar, culture vessel (size, type, sealant, ventilation) months, years, ambient, 25°C, 4°C, -20°C, -80°C; RH, 80%, 20%, 15%, 5%; arrested metabolism, minimal nutrients, T˚C light, growth factors, growth inhibitors; subculture cycle, weeks, months, years. |
| *LIMS*  *SPREC* | **V.b** | **Cryopreservation**  Pre-growth, pre-treatment  cryoprotection regime, cooling regime, cryogenic state, temperature, storage duration  *Procedures used to establish and maintain base collections of viable cells, tissues, organs in long-term storage. Also termed cryo-conservation.* | N/A for non-viable collections. | Osmotica and special additives,  colligative, non-colligative cryoprotectants, alginate, controlled rate, rapid, ultra rapid cooling programmable freezer, Mr Frosty®, frozen, partially vitrified, vitrified, -196°C (LN vapour phase >. -130°C), mechanical freezers, years, decades, multiple decades |
| *SPREC* | **V.c** | **Rewarming & recovery**  *Conditions used to retrieve, revive and recover after storage.* | *N/A for non-viable museum collections.* | Rapid, slow or controlled re-warming at ambient or water bath (40 - 45°C ), Culture vessel (size, type, sealant, ventilation). recovery *in vitro* culture, media, special additives, ambient, T˚C, dark, light. |
|  |  | **VI. DISPATCH, TRANSPORT, COLD CHAIN SECURITY** | | |
| *SPREC* | **VI.a** | **Shipping temperature & conditions**  Shipping parameters, freeze/thaw cooling/rewarming,  duration of thaw/rewarming, time from thaw/rewarming to end use;  temperature between thaw/use  *Stabilizing conditions applied to samples transferred, relocated, dispatched to end user.* | ambient, chilled (wet ice), -20°C (dry ice), -80°C (dry ice), -196°C (dry shipper), log of sample temp and shipment time. | *In vitro* cultures: ambient/chilled; cryopreserved: -196°C (or LN, vapour phase ca. >130°C), dry ice, Dry Shipper, log of critical cold chain parameters freeze/thaw cool / rewarming.. |
|  |  | **VII. QUALITY ASSURANCE & QUALITY CONTROL MEASURES** | | |
| LIMS | **VII.a** | **Quality management**  Measuresthat assure sample quality outcomes, down-stream analyses*.*  *QA/QC comprise validated measures [including acceptance / rejection thresholds, quality standards] used to test procedures and sample quality before and after storage, and dispatch, to assure fitness-for-purpose for end users.* | Authentication and taxonomic ID guarantee (for museum collections) QA/QC fitness-for-purpose testing: multiple end point analyses and functional biomarkers, e.g. (viability, apoptosis, regrowth, totipotency, morphogenetic), metabolic, biosynthetic, epigenetic, genetic stability. Fulfilment of BRC principles: authenticity, purity, stability. Self assessments for QA/QC; pre-analytical variables / SPREC; BRISQ check lists. Incorporation of SPREC, BRISQ tools into QMS and CMS data bases. External quality assurance measures. | |