S1 Appendix. Clavis JSON-schema

```
{
 "$schema": "http://json-schema.org/draft-07/schema#",
 "title": "Clavis identification key schema",
 "description": "Clavis-compliant keys contain knowledge that may be
used to distinguish taxa from each other.",
  "type": "object",
 "required": [
    "$schema",
    "title",
    "language",
    "license",
                                                                             11
    "creator",
    "lastModified",
    "identifier",
    "taxa",
    "characters",
                                                                             16
    "statements"
 "properties": {
    "$schema": {
     "description": "The schema url of (this) schema defining the
format of the key.",
      "$ref": "#/definitions/url"
    },
    "title": {
      "description": "The name of the key",
      "comment": "Accepts array for multilingual support.",
      "$ref": "#/definitions/localizedString",
     "examples": [
        "Birds of Norway"
     ]
    },
    "media": {
      "description": "The logo/illustration image of the key.",
      "$ref": "#/definitions/mediaID"
    },
    "description": {
     "description": "Short description of the key (valid markdown).",
      "comment": "Accepts array for multilingual support.",
     "$ref": "#/definitions/localizedString",
      "contentMediaType": "text/markdown"
    },
    "descriptionDetails": {
      "description": "Extended description of the key that supplements
the description (valid markdown).",
      "comment": "Accepts array for multilingual support.",
```

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```
"$ref": "#/definitions/localizedString",
      "contentMediaType": "text/markdown"
    },
    "descriptionUrl": {
      "description": "Hyperlink to more information on the key (valid
url).",
      "comment": "Accepts array for multilingual support.",
      "$ref": "#/definitions/localizedUrl"
    },
    "audience": {
      "description": "Description of the intended audience for the
key.",
      "comment": "Accepts array for multilingual support.",
      "$ref": "#/definitions/localizedString",
      "examples": [
        "Undergraduate students and up."
    },
    "source": {
      "description": "Source of the key.",
      "comment": "Accepts array for multilingual support.",
      "$ref": "#/definitions/localizedString",
      "examples": [
        "Koch, Wouter (2019). Birds of Norway. ISBN 1234567890"
      ]
    },
    "sourceUrl": {
      "description": "Hyperlink to the source of the key (valid url).",
      "comment": "Accepts array for multilingual support.",
      "$ref": "#/definitions/localizedUrl",
      "examples": [
        "https://doi.org/10.1126/science.1251554"
      ٦
    },
    "regionName": {
      "description": "The name of the region for which the key is valid
(e.g. covers all subtaxa).",
      "comment": "Accepts array for multilingual support.",
      "$ref": "#/definitions/localizedString",
      "examples": [
        "Norway",
        "Europe",
        "Trøndelag",
          "Norge",
          "Norway"
      ]
    },
    "geography": {
      "description": "The region for which the key is valid (e.g. covers
all subtaxa), represented as the coordinates array of a GeoJSON
```

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```
MultiPolygon.",
                                                                                      99
       "$ref": "#/definitions/multiPolygon"
                                                                                     100
                                                                                     101
     "primaryContact": {
                                                                                     102
       "description": "The organization- or person-id that is the main
                                                                                     103
contact point for the key.",
       "oneOf": [
                                                                                     105
           "$ref": "#/definitions/personID"
                                                                                     107
         },
                                                                                     108
         {
                                                                                     109
           "$ref": "#/definitions/organizationID"
         }
                                                                                     111
       ]
                                                                                     112
    },
                                                                                     113
    "creator": {
                                                                                     114
       "description": "The id(s) of the creator(s) of the key",
                                                                                     115
       "oneOf": [
                                                                                     116
         {
                                                                                     117
           "$ref": "#/definitions/personID"
                                                                                     118
         },
                                                                                     119
                                                                                     120
           "type": "array",
           "items": {
                                                                                     122
              "$ref": "#/definitions/personID"
                                                                                     124
         }
                                                                                     125
       ]
                                                                                     126
    },
     "contributor": {
                                                                                     128
       "description": "The id(s) of the contributor(s) of the key",
       "oneOf": [
                                                                                     130
         {
                                                                                     131
           "$ref": "#/definitions/personID"
                                                                                     132
         },
                                                                                     133
         {
                                                                                     134
           "type": "array",
                                                                                     135
           "items": {
              "$ref": "#/definitions/personID"
                                                                                     137
         }
                                                                                     139
       ]
    },
                                                                                     141
     "publisher": {
                                                                                     142
       "description": "The id(s) of the publising institutions of the
                                                                                     143
key.",
       "oneOf": [
                                                                                     145
         {
           "$ref": "#/definitions/organizationID"
                                                                                     147
         },
                                                                                     148
         {
                                                                                     149
           "type": "array",
                                                                                     150
```

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```
"items": {
                                                                                    151
             "$ref": "#/definitions/organizationID"
                                                                                    152
                                                                                    153
         }
      ]
                                                                                    155
    },
                                                                                    156
    "license": {
                                                                                    157
      "description": "The url to the license under which the key
falls.",
                                                                                    159
      "$ref": "#/definitions/url",
                                                                                    160
      "examples": [
                                                                                    161
         "https://creativecommons.org/licenses/by/4.0/"
                                                                                    163
    },
                                                                                    164
    "language": {
                                                                                    165
      "description": "The ISO 639-1 code(s) of the key language(s).",
                                                                                    166
      "comment": "String for a single language, array of strings for
                                                                                    167
multilingual support. If used as an array, be sure to use the
                                                                                    168
localizedString and localizedUrl as arrays too.",
       "oneOf": [
                                                                                    170
                                                                                    171
           "type": "string",
                                                                                    172
           "pattern": "^[a-z]{2}$"
         },
                                                                                    174
           "type": "array",
                                                                                    176
           "items": {
             "type": "string",
                                                                                    178
             "pattern": "^[a-z]{2}$"
                                                                                    180
         }
      ],
                                                                                    182
      "examples": [
                                                                                    183
         "en",
                                                                                    184
         "nb"
                                                                                    185
                                                                                    186
           "en",
                                                                                    187
           "nb"
         ]
                                                                                    189
      ]
    },
                                                                                    191
    "created": {
      "description": "The moment the key was made or first published, as
                                                                                    193
'YYYY-MM-DD hh:mm:ss'.",
                                                                                    194
      "type": "string",
                                                                                    195
       "pattern": "^20\d\d-(0[1-9]|1[0-2])-([012]\d|3[01])
([01]\d|2[0-3]):([0-5]\d):([0-5]\d)",
                                                                                    197
      "examples": [
         "2019-05-21 22:51:55"
                                                                                    199
      ]
                                                                                    200
    },
                                                                                    201
    "lastModified": {
                                                                                    202
```

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```
"description": "The most recent moment the key was modified, as
                                                                                 203
'YYYY-MM-DD hh:mm:ss'.",
                                                                                 204
      "type": "string",
                                                                                 205
      "pattern": "^20\d\d-(0[1-9]|1[0-2])-([012]\d|3[01])
([01]\d|2[0-3]):([0-5]\d):([0-5]\d)",
                                                                                 207
      "examples": [
                                                                                 208
        "2019-05-21 22:51:55"
                                                                                 209
      ٦
    },
                                                                                 211
    "identifier": {
                                                                                 212
      "description": "The GUID of this key (persistent regardless of
                                                                                 213
version).",
      "type": "string"
                                                                                 215
    },
                                                                                 216
    "url": {
                                                                                 217
      "description": "The url of where the key lives (to check for newer
                                                                                 218
versions).",
                                                                                 219
      "$ref": "#/definitions/url"
                                                                                 220
    },
                                                                                 221
    "externalServices": {
                                                                                 222
      "description": "Services used by the key for lookups of images,
                                                                                 223
taxa, etc.",
                                                                                 224
      "type": "array",
      "items": {
                                                                                 226
         "$ref": "#/definitions/externalService"
      }
    },
    "userRequirements": {
                                                                                 230
      "description": "Requirements to the users of the various
characters, so that the user can be warned, helped, etc.",
                                                                                 232
      "type": "array",
      "items": {
                                                                                 234
         "$ref": "#/definitions/userRequirement"
                                                                                 235
      }
                                                                                 236
    },
                                                                                 237
    "taxa": {
      "description": "Taxa (e.g. species) the key can resolve to. Do not
                                                                                239
have to be exclusively taxonomic units.",
      "comment": "Taxa to which the key can resolve. Either the taxa
                                                                                 241
directly or their children. SubTaxonomic taxa (such as morphs, genders,
life stages) should be presented through their parent only.",
                                                                                 243
      "type": "array",
      "items": {
                                                                                 245
        "$ref": "#/definitions/taxon"
                                                                                 246
      }
                                                                                 247
    },
    "characters": {
                                                                                 249
      "description": "Characters (questions, e.g. 'Wing color' or
'Number of spots') used to distinguish between two or more taxa.",
                                                                                 251
      "type": "array",
      "items": {
                                                                                 253
        "$ref": "#/definitions/character"
                                                                                 254
```

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```
}
                                                                                  255
    },
                                                                                  256
    "statements": {
                                                                                  257
      "description": "Relationships between taxa and character states
(or lack thereof) that define those taxa.",
                                                                                  259
      "type": "array",
      "items": {
                                                                                  261
         "$ref": "#/definitions/statement"
                                                                                  263
    },
                                                                                  264
    "persons": {
      "description": "Persons that are connected to (parts of) the key,
such as creators.",
                                                                                  267
      "type": "array",
      "items": {
                                                                                  269
         "$ref": "#/definitions/person"
                                                                                  270
                                                                                  271
    },
                                                                                  272
    "organizations": {
                                                                                  273
      "description": "Organizations that are connected to (parts of) the
                                                                                  274
key or persons, such as employers and publishers.",
                                                                                  275
      "type": "array",
                                                                                  276
      "items": {
         "$ref": "#/definitions/organization"
                                                                                  278
      }
    },
    "mediaElements": {
      "description": "Media elements that are used in the key.",
                                                                                  282
      "type": "array",
      "items": {
                                                                                  284
         "$ref": "#/definitions/localizedMediaElement"
                                                                                  286
    }
                                                                                  287
  },
                                                                                  288
  "definitions": {
                                                                                  289
    "localizedString": {
                                                                                  290
      "description": "Language-dependent string or object of strings,
                                                                                  291
with keys corresponding to the languages supported by the key.",
      "oneOf": [
                                                                                  293
         {
           "type": "string"
                                                                                  295
        },
                                                                                  297
           "type": "object",
           "propertyNames": {
             "pattern": "^[a-z]{2}$"
           },
                                                                                  301
           "properties": {},
           "additionalProperties": {
                                                                                  303
             "type": "string"
           }
                                                                                  305
        }
                                                                                  306
```

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```
]
                                                                                    307
    },
                                                                                    308
    "localizedUrl": {
                                                                                    309
       "description": "Language-dependent urls or object of urls,
                                                                                    310
corresponding to the languages supported by the key.",
                                                                                    311
      "oneOf": [
                                                                                    312
         {
                                                                                    313
           "$ref": "#/definitions/url"
         },
                                                                                    315
                                                                                    316
           "type": "object",
                                                                                    317
           "propertyNames": {
             "pattern": "^[a-z]{2}$"
                                                                                    319
           },
                                                                                    320
           "properties": {},
                                                                                    321
           "additionalProperties": {
                                                                                    322
             "$ref": "#/definitions/url"
                                                                                    323
                                                                                    324
        }
      ]
                                                                                    326
    },
                                                                                    327
    "localizedMediaElement": {
                                                                                    328
       "type": "object",
       "description": "Language-dependent media element or object of
                                                                                    330
media elements, corresponding to the languages supported by the key.",
      "properties": {
                                                                                    332
         "id": {
                                                                                    333
           "description": "Internally unique id of the localized media
                                                                                    334
element.",
           "$ref": "#/definitions/mediaID"
                                                                                    336
         },
         "mediaElement": {
                                                                                    338
           "description": "The media element or media elements (one for
                                                                                    339
each language).",
           "oneOf": [
                                                                                    341
                                                                                    342
                "$ref": "#/definitions/mediaElement"
                                                                                    343
             },
                                                                                    345
                "type": "object",
                "propertyNames": {
                                                                                    347
                  "pattern": "^[a-z]{2}$"
               },
                                                                                    349
                "properties": {},
                                                                                    350
                "additionalProperties": {
                                                                                    351
                  "$ref": "#/definitions/mediaElement"
                                                                                    353
             }
           ]
                                                                                    355
        }
      }
                                                                                    357
    },
                                                                                    358
```

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```
"url": {
                                                                               359
      "description": "String formed as a url, or an external
                                                                               360
resource.",
                                                                               361
      "oneOf": [
                                                                               363
          "type": "string",
          "format": "uri"
                                                                               365
        },
                                                                               367
          "$ref": "#/definitions/externalResource"
      ]
    },
                                                                               371
    "taxonID": {
      "description": "String used as an internal ID for a taxon.
                                                                               373
Lowercase alphanumerical and underscores are allowed.",
      "type": "string",
                                                                               375
      "pattern": "^taxon:[a-z0-9_]+$"
                                                                               376
    },
                                                                               377
    "characterID": {
                                                                               378
      "description": "String used as an internal ID for a character.
                                                                               379
Lowercase alphanumerical and underscores are allowed.",
                                                                               380
      "type": "string",
      "pattern": "^character:[a-z0-9_]+$"
                                                                               382
    },
    "stateID": {
      "description": "String used as an internal ID for a state.
Lowercase alphanumerical and underscores are allowed.",
                                                                               386
      "type": "string",
      "pattern": "^state:[a-z0-9_]+$"
    },
    "personID": {
                                                                               390
      "description": "String used as an internal ID for a person.
                                                                               391
Lowercase alphanumerical and underscores are allowed.",
      "type": "string",
                                                                               393
      "pattern": "^person:[a-z0-9_]+$"
                                                                               394
                                                                               395
    "organizationID": {
      "description": "String used as an internal ID for an organization.
Lowercase alphanumerical and underscores are allowed.",
      "type": "string",
                                                                               399
      "pattern": "^organization:[a-z0-9_]+$"
    },
                                                                               401
    "serviceID": {
      "description": "String used as an internal ID for a service.
                                                                               403
Lowercase alphanumerical and underscores are allowed.",
      "type": "string",
                                                                               405
      "pattern": "^service:[a-z0-9_]+$"
    },
                                                                               407
    "statementID": {
      "description": "String used as an internal ID for a statement.
                                                                               409
Lowercase alphanumerical and underscores are allowed.",
                                                                               410
```

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```
"type": "string",
                                                                                 411
      "pattern": "^statement:[a-z0-9_]+$"
                                                                                 412
    },
                                                                                 413
    "userRequirementID": {
                                                                                 414
      "description": "String used as an internal ID for a user
                                                                                 415
requirement. Lowercase alphanumerical and underscores are allowed.",
                                                                                 416
      "type": "string",
                                                                                 417
      "pattern": "^requirement:[a-z0-9_]+$"
    },
                                                                                 419
    "mediaID": {
                                                                                 420
      "description": "String used as an internal ID for a media element.
                                                                                 421
Lowercase alphanumerical and underscores are allowed.",
      "type": "string",
                                                                                 423
      "pattern": "^media:[a-z0-9_]+$"
    },
    "mediaFile": {
      "type": "object",
                                                                                 427
      "properties": {
                                                                                 428
        "title": {
           "description": "The title of the media file.",
                                                                                 430
           "$ref": "#/definitions/localizedString"
                                                                                 431
        },
                                                                                 432
        "url": {
           "description": "The reference to the media file (url or
                                                                                 434
resource).",
           "$ref": "#/definitions/url"
        },
                                                                                 437
        "file": {
                                                                                 438
           "description": "The actual media file (base64 or svg) as a
data URI scheme.",
                                                                                 440
           "oneOf": [
                                                                                 442
               "type": "string",
                                                                                 443
               "pattern": "^data:([a-z0-9/]+);base64,([a-zA-Z0-9+/=]+)$"
             },
                                                                                 445
                                                                                 446
               "type": "string",
                                                                                 447
               "pattern": "^data:image/svg\+xml;utf8,(.*)$"
                                                                                 449
          ]
                                                                                 450
        },
                                                                                 451
        "width": {
           "description": "The number of pixels horizontally (if a bitmap
                                                                                 453
image or video).",
           "type": "integer"
        },
        "height": {
                                                                                 457
           "description": "The number of pixels vertically (if a bitmap
image or video).",
           "type": "integer"
                                                                                 460
        },
                                                                                 461
        "length": {
                                                                                 462
```

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```
"description": "The length in seconds of an audio or video
                                                                                    463
file.",
                                                                                    464
           "type": "integer"
                                                                                    465
         },
         "placeholder": {
                                                                                    467
           "description": "Image file that can be shown instead of the
                                                                                    468
video or audio file.",
                                                                                    469
           "$ref": "#/definitions/mediaID"
         },
                                                                                    471
         "creator": {
           "description": "The id(s) of the creator(s) of the media
                                                                                    473
file",
           "oneOf": [
                                                                                    475
             {
                                                                                    476
                "$ref": "#/definitions/personID"
                                                                                    477
             },
                                                                                    478
             {
                                                                                    479
                "type": "array",
                                                                                    480
                "items": {
                  "$ref": "#/definitions/personID"
                                                                                    482
                                                                                    483
             }
                                                                                    484
           ]
         },
                                                                                    486
         "contributor": {
           "description": "The id(s) of the contributor(s) of the media
file",
           "oneOf": [
                                                                                    490
                "$ref": "#/definitions/personID"
                                                                                    492
             },
                                                                                    494
                "type": "array",
                                                                                    495
                "items": {
                  "$ref": "#/definitions/personID"
                                                                                    497
               }
                                                                                    498
             }
                                                                                    499
           ]
         },
                                                                                    501
         "publisher": {
           "description": "The id(s) of the publising institutions of the
                                                                                    503
media file.",
           "oneOf": [
                                                                                    505
                                                                                    506
                "$ref": "#/definitions/organizationID"
                                                                                    507
             },
                                                                                    509
                "type": "array",
                                                                                    510
                "items": {
                                                                                    511
                  "$ref": "#/definitions/organizationID"
                                                                                    512
               }
                                                                                    513
             }
                                                                                    514
```

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```
]
                                                                                    515
        },
                                                                                    516
         "license": {
                                                                                    517
           "description": "The url to the license under which the media
                                                                                    518
file falls.",
                                                                                    519
           "$ref": "#/definitions/url",
           "examples": [
                                                                                    521
             "https://creativecommons.org/licenses/by/4.0/"
                                                                                    523
        }
                                                                                    524
      }
                                                                                    525
    },
    "mediaElement": {
                                                                                    527
      "description": "A media element (collection of various formats of
the same media object).",
                                                                                    529
      "type": "object",
                                                                                    530
      "properties": {
                                                                                    531
         "file": {
                                                                                    532
           "description": "The various formats of the same media
object.",
                                                                                    534
           "oneOf": [
                                                                                    535
                                                                                    536
                "$ref": "#/definitions/mediaFile"
             },
                                                                                    538
               "type": "array",
                                                                                    540
               "items": {
                  "$ref": "#/definitions/mediaFile"
                                                                                    542
               }
             }
                                                                                    544
           ]
        }
                                                                                    546
      }
                                                                                    547
    },
    "multiPolygon": {
                                                                                    549
      "description": "The coordinates array of a GeoJSON
                                                                                    550
MultiPolygon.",
                                                                                    551
      "type": "array",
      "items": {
                                                                                    553
         "type": "array",
         "items": {
                                                                                    555
           "type": "array",
           "items": {
                                                                                    557
             "type": "array",
                                                                                    558
             "items": {
                                                                                    559
                "type": "number"
                                                                                    561
           }
        }
                                                                                    563
      }
    },
                                                                                    565
    "externalResource": {
                                                                                    566
```

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```
"description": "A resource managed elsewhere.",
                                                                                   567
      "type": "object",
                                                                                   568
      "properties": {
                                                                                   569
         "serviceId": {
           "description": "The id to one of the externalServices
                                                                                   571
defined.",
                                                                                   572
           "$ref": "#/definitions/serviceID"
                                                                                   573
        },
         "externalId": {
                                                                                   575
           "description": "The id of the resource at the
                                                                                   576
externalService.",
                                                                                   577
           "type": "string"
        }
                                                                                   579
      }
                                                                                   580
    },
                                                                                   581
    "externalService": {
      "description": "Service used by the key, for media files, taxonomy
and/or nomenclature, species distributions, etc.",
                                                                                   584
      "type": "object",
      "required": [
                                                                                   586
        "id"
                                                                                   587
      ],
                                                                                   588
      "properties": {
         "id": {
                                                                                   590
           "description": "Internally unique id to the service.",
           "$ref": "#/definitions/serviceID"
                                                                                   592
        },
                                                                                   593
         "title": {
                                                                                   594
           "description": "Name of the service.",
           "type": "string"
                                                                                   596
        },
         "provider": {
                                                                                   598
           "description": "Provider of the service.",
                                                                                   599
           "type": "string"
                                                                                   600
        },
                                                                                   601
         "url": {
                                                                                   602
           "description": "Url for the service documentation.",
                                                                                   603
           "$ref": "#/definitions/url"
        }
                                                                                   605
      }
    },
                                                                                   607
    "person": {
      "type": "object",
                                                                                   609
      "required": [
                                                                                   610
        "id",
                                                                                   611
         "name"
      ],
                                                                                   613
      "properties": {
                                                                                   614
         "id": {
                                                                                   615
           "$ref": "#/definitions/personID"
                                                                                   616
        },
                                                                                   617
         "name": {
                                                                                   618
```

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```
"description": "Full name of the person",
                                                                                  619
           "comment": "Accepts object for multilingual support.",
                                                                                  620
           "$ref": "#/definitions/localizedString"
                                                                                  621
        },
        "email": {
                                                                                  623
           "description": "Email address of the person",
                                                                                  624
           "type": "string",
                                                                                  625
           "format": "email"
        },
                                                                                  627
        "url": {
           "description": "Hyperlink to more information on the person
(valid url).",
           "comment": "Accepts object for multilingual support.",
                                                                                  631
           "$ref": "#/definitions/localizedUrl"
                                                                                  632
        },
                                                                                  633
        "media": {
                                                                                  634
           "description": "A media file (image) representing the
                                                                                  635
person.",
                                                                                  636
           "$ref": "#/definitions/mediaID"
        },
                                                                                  638
        "affiliation": {
                                                                                  639
           "description": "Organization id(s) the person is affiliated
                                                                                  640
with.",
           "oneOf": [
                                                                                  642
             {
               "$ref": "#/definitions/organizationID"
                                                                                  644
             },
                                                                                  646
               "type": "array",
               "items": {
                                                                                  648
                 "$ref": "#/definitions/organizationID"
                                                                                  650
             }
                                                                                  651
           ]
                                                                                  652
        }
                                                                                  653
      }
                                                                                  654
    },
                                                                                  655
    "organization": {
      "type": "object",
                                                                                  657
      "required": [
        "id",
                                                                                  659
        "name"
      ],
                                                                                  661
      "properties": {
                                                                                  662
        "id": {
                                                                                  663
           "$ref": "#/definitions/organizationID"
        },
                                                                                  665
        "name": {
           "description": "Name of the organization",
                                                                                  667
           "comment": "Accepts object for multilingual support.",
           "$ref": "#/definitions/localizedString"
                                                                                  669
        },
                                                                                  670
```

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```
"url": {
                                                                                671
          "description": "Hyperlink to more information on the
                                                                                672
organization (valid url).",
                                                                                673
          "comment": "Accepts object for multilingual support.",
          "$ref": "#/definitions/localizedUrl"
                                                                                675
        },
                                                                                676
        "primaryContact": {
                                                                                677
          "description": "The person-id that is the main contact point
for the organization.",
                                                                                679
          "$ref": "#/definitions/personID"
        },
        "media": {
          "description": "A media file (image) representing the
                                                                                683
organization, such as a logo.",
          "$ref": "#/definitions/mediaID"
        }
      }
                                                                                687
    },
                                                                                688
    "userRequirement": {
      "type": "object",
                                                                                690
      "required": [
                                                                                691
        "id"
                                                                                692
      ],
      "properties": {
                                                                                694
        "id": {
          "$ref": "#/definitions/userRequirementID"
        },
        "title": {
                                                                                698
          "comment": "Accepts array for multilingual support.",
          "$ref": "#/definitions/localizedString"
                                                                                700
        },
        "warning": {
                                                                                702
          "comment": "Accepts array for multilingual support.",
                                                                                703
          "$ref": "#/definitions/localizedString"
        },
                                                                                705
        "description": {
          "description": "Short description of the requirements to the
                                                                                707
user (valid markdown).",
          "comment": "Accepts object for multilingual support.",
                                                                                709
          "$ref": "#/definitions/localizedString",
          "contentMediaType": "text/markdown"
                                                                                711
        },
        "descriptionDetails": {
                                                                                713
          "description": "Extended description of the requirements to
                                                                                714
the user that supplements the description (valid markdown).",
                                                                                715
          "comment": "Accepts object for multilingual support.",
          "$ref": "#/definitions/localizedString",
                                                                                717
          "contentMediaType": "text/markdown"
        },
                                                                                719
        "descriptionUrl": {
          "description": "Hyperlink to more information on the
                                                                                721
requirements to the user (valid url).",
                                                                                722
```

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```
"comment": "Accepts object for multilingual support.",
                                                                                    723
           "$ref": "#/definitions/localizedUrl"
                                                                                    724
        },
                                                                                    725
         "media": {
           "description": "Media or illustration that informs the user on
                                                                                   727
the requirements to the user.",
           "comment": "Accepts object for multilingual support.",
                                                                                    729
           "$ref": "#/definitions/mediaID"
                                                                                    731
      }
                                                                                    732
    },
                                                                                    733
    "taxon": {
      "type": "object",
                                                                                    735
      "oneOf": [
         {
                                                                                    737
           "required": [
             "id",
                                                                                    739
             "scientificName"
                                                                                    740
           1
        },
                                                                                    742
                                                                                    743
           "required": [
                                                                                    744
             "id",
             "externalReference"
                                                                                    746
           ]
        },
                                                                                    748
           "required": [
                                                                                    750
             "id",
             "label"
                                                                                    752
           1
        }
                                                                                    754
      ],
                                                                                    755
      "properties": {
         "id": {
                                                                                    757
           "description": "Internally unique id to the taxon.",
                                                                                    758
           "$ref": "#/definitions/taxonID"
                                                                                    759
        },
         "scientificName": {
                                                                                    761
           "description": "Scientific name of the taxon.",
           "minLength": 5,
                                                                                    763
           "type": "string",
           "examples": [
                                                                                    765
             "Vulpes lagopus"
                                                                                    766
           ]
                                                                                    767
        },
         "scientificNameAuthor": {
                                                                                    769
           "description": "Author string of the scientific name of the
taxon.",
                                                                                    771
           "type": "string",
           "examples": [
                                                                                    773
             "Koch, 1888"
                                                                                    774
```

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```
1
                                                                                775
        },
                                                                                776
        "placeholderName": {
                                                                                777
           "description": "Name that can be shown while fetching the name
externally. Also useful for editing the key.",
                                                                                779
           "comment": "Accepts object for multilingual support.",
           "$ref": "#/definitions/localizedString",
                                                                                781
           "examples": [
             "B. hortorum (melanistic queen)"
                                                                                783
          ]
        },
        "vernacularName": {
           "description": "Vernacular name of the taxon.",
                                                                                787
          "comment": "Accepts object for multilingual support.",
           "$ref": "#/definitions/localizedString",
           "examples": [
             "fjellrev",
                                                                                791
             {
                                                                                792
               "no": "fjellrev",
               "en": "Arctic Fox"
                                                                                794
                                                                                795
          ]
        },
        "media": {
           "description": "Media elements of the taxon.",
           "oneOf": [
               "$ref": "#/definitions/mediaID"
                                                                                802
            },
                                                                                804
               "type": "array",
               "items": {
                                                                                806
                 "$ref": "#/definitions/mediaID"
                                                                                807
                                                                                808
            }
                                                                                809
          ]
                                                                                810
        },
                                                                                811
        "description": {
           "description": "Short description of the taxon (valid
                                                                                813
markdown).",
           "comment": "Accepts object for multilingual support.",
                                                                                815
           "$ref": "#/definitions/localizedString",
           "contentMediaType": "text/markdown"
                                                                                817
        },
                                                                                818
        "descriptionDetails": {
           "description": "Extended description of the taxon that
supplements the description (valid markdown).",
                                                                                821
           "comment": "Accepts object for multilingual support.",
           "$ref": "#/definitions/localizedString",
                                                                                823
           "contentMediaType": "text/markdown"
        },
                                                                                825
        "descriptionUrl": {
```

826

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```
"description": "Hyperlink or resource to more information on
                                                                                 827
the taxon.",
                                                                                 828
           "comment": "Accepts object for multilingual support.",
                                                                                 829
          "$ref": "#/definitions/localizedUrl"
        },
                                                                                 831
        "rank": {
                                                                                 832
           "description": "Name of the level of the taxon.",
                                                                                 833
           "comment": "Accepts object for multilingual support.",
           "$ref": "#/definitions/localizedString",
                                                                                 835
           "examples": [
             "slekt",
                                                                                 837
             {
               "no": "slekt".
                                                                                 839
               "en": "genus"
                                                                                 841
          ]
        },
                                                                                 843
        "label": {
                                                                                 844
           "description": "Type of morph of the taxon.",
           "type": "string",
                                                                                 846
           "minLength": 0,
                                                                                 847
           "examples": [
                                                                                 848
             "male",
             "Ω",
                                                                                 850
             "larva"
          ]
                                                                                 852
        },
        "isEndPoint": {
                                                                                 854
           "description": "Whether the key should stop when this taxon is
the only remaining possibility, even when it has multiple children
                                                                                 856
remaining.",
           "comment": "Default is FALSE (if not specified). A taxon
                                                                                 858
without children is alway an endpoint by definition, unless one of its
                                                                                 859
ancestors overrides this by being specified as an endpoint.",
           "type": "boolean"
                                                                                 861
        },
                                                                                 862
        "children": {
                                                                                 863
           "type": "array",
           "items": {
                                                                                 865
             "$ref": "#/definitions/taxon"
          }
                                                                                 867
        },
        "externalReference": {
                                                                                 869
           "description": "Reference to a taxon at a provider, as an
object wiht a provider id and a taxon id at that provider.",
                                                                                 871
           "comment": "Accepts object for multilingual support.",
           "oneOf": [
                                                                                 873
             {
               "$ref": "#/definitions/externalResource"
                                                                                 875
             },
                                                                                 877
               "type": "object",
                                                                                 878
```

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```
"propertyNames": {
                "pattern": "^[a-z]{2}$"
              },
              "properties": {},
              "additionalProperties": {
                "$ref": "#/definitions/externalResource"
            }
          ]
        },
        "followUp": {
          "description": "Url or reference to instance at external
service for a key for this taxon, that for instance can be used to
identify to a lower rank than the current key can.",
          "comment": "Accepts array for multilingual support.",
          "$ref": "#/definitions/localizedUrl"
        },
        "geography": {
          "description": "The area(s) in which the taxon occurs,
represented as the coordinates array of a GeoJSON MultiPolygon.",
          "$ref": "#/definitions/multiPolygon"
        },
        "geographyService": {
          "description": "An url or external service that returns
distribution information for this taxon.",
          "$ref": "#/definitions/url"
        }
      }
    },
    "character": {
      "type": "object",
      "required": [
        "id",
        "title",
        "states"
      ],
      "properties": {
        "id": {
          "description": "Internally unique id to the character.",
          "$ref": "#/definitions/characterID"
        },
        "title": {
          "description": "Name of the character.",
          "comment": "Accepts array for multilingual support.",
          "$ref": "#/definitions/localizedString",
          "examples": [
            "Color of the wings"
          1
        },
        "media": {
          "description": "The media element(s) of the character. Can be
used to inform user of relevant structures etc.",
```

879

880

881

883

884 885

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923

925

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```
"oneOf": [
                                                                                931
            {
                                                                                932
               "$ref": "#/definitions/mediaID"
                                                                                933
            },
                                                                                935
               "type": "array",
               "items": {
                                                                                937
                 "$ref": "#/definitions/mediaID"
                                                                                939
            }
          ]
                                                                                941
        },
        "description": {
                                                                                943
          "description": "Short description of the character (valid
markdown).",
          "comment": "Accepts object for multilingual support.",
          "$ref": "#/definitions/localizedString",
                                                                                947
          "contentMediaType": "text/markdown"
                                                                                948
        },
        "descriptionDetails": {
                                                                                950
          "description": "Extended description of the character that
                                                                                951
supplements the description (valid markdown).",
                                                                                952
          "comment": "Accepts object for multilingual support.",
          "$ref": "#/definitions/localizedString",
                                                                                954
          "contentMediaType": "text/markdown"
        },
                                                                                956
        "descriptionUrl": {
          "description": "Hyperlink or resource to more information on
                                                                                958
the character.",
          "comment": "Accepts object for multilingual support.",
                                                                                960
          "$ref": "#/definitions/localizedUrl"
        },
                                                                                962
        "type": {
                                                                                963
          "description": "Type of the character (exclusive when states
are catagorical and mutually exclusive, non-exclusive when these are
                                                                                965
non-exclusive, or numerical when the state is numerical).",
          "comment": "Default is exclusive (if not specified).",
                                                                                967
          "type": "string",
          "enum": [
                                                                                969
             "exclusive",
            "non-exclusive",
                                                                                971
             "numerical"
          ]
                                                                                973
        },
        "userRequirement": {
          "description": "Id to the userRequirement required to answer
this character.",
                                                                                977
          "comment": "Has to be one of the userRequirement defined on
the key level.",
          "$ref": "#/definitions/userRequirementID"
                                                                                981
        "logicalPremise": {
                                                                                982
```

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```
"description": "Logical requirement that has to be fulfilled
                                                                                       983
for this question to be asked.",
                                                                                       984
           "comment": "Has to refer to stateIds, that have to be fully
                                                                                       985
true (either answered or all alternatives ruled out). Can use !, &&, ||,
(, ), <, >, =.",
                                                                                       987
           "type": "string",
                                                                                       988
           "pattern": "^(( && )|( \|\|
                                                                                       989
)|(&&)|(\|\|)|[a-z0-9_:()!<>=])+$"
         },
                                                                                       991
         "states": {
                                                                                       992
           "oneOf": [
                                                                                       993
                "type": "array",
                                                                                       995
                "items": {
                  "$ref": "#/definitions/state"
                                                                                       997
                }
             },
                                                                                       aga
              {
                                                                                      1000
                "$ref": "#/definitions/state"
                                                                                      1001
             }
                                                                                      1002
           ]
                                                                                      1003
         }
                                                                                      1004
      }
    },
                                                                                      1006
    "state": {
                                                                                      1007
      "description": "The value a character can have.",
                                                                                      1008
       "type": "object",
                                                                                      1009
       "oneOf": [
                                                                                      1010
         {
                                                                                      1011
           "required": [
                                                                                      1012
              "id",
                                                                                      1013
              "title"
                                                                                      1014
           ]
                                                                                      1015
         },
                                                                                      1016
         {
                                                                                      1017
           "required": [
                                                                                      1018
              "id",
                                                                                      1019
              "min",
                                                                                      1020
              "max",
                                                                                      1021
              "stepSize",
                                                                                      1022
              "unit"
                                                                                      1023
           ]
         }
                                                                                      1025
      ],
                                                                                      1026
       "properties": {
                                                                                      1027
         "id": {
           "description": "Internally unique id of the state.",
                                                                                      1029
           "$ref": "#/definitions/stateID"
                                                                                      1030
         },
                                                                                      1031
         "title": {
                                                                                      1032
           "description": "Content of the state.",
                                                                                      1033
           "comment": "Only to be used for catergorical characters.
                                                                                      1034
```

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```
Accepts object for multilingual support.",
                                                                                  1035
           "$ref": "#/definitions/localizedString"
                                                                                  1036
        },
                                                                                  1037
         "media": {
                                                                                  1038
           "description": "Media element(s) that illustrate the state.",
                                                                                  1039
           "oneOf": [
                                                                                  1040
             {
                                                                                  1041
               "$ref": "#/definitions/mediaID"
             },
                                                                                  1043
             {
                                                                                  1044
               "type": "array",
                                                                                  1045
               "items": {
                  "$ref": "#/definitions/mediaID"
                                                                                  1047
               }
                                                                                  1048
             }
                                                                                  1049
           ]
                                                                                  1050
        },
                                                                                  1051
        "description": {
                                                                                  1052
           "description": "Short description of the state (valid
                                                                                  1053
markdown).",
                                                                                  1054
           "comment": "Accepts object for multilingual support.",
                                                                                  1055
           "$ref": "#/definitions/localizedString",
                                                                                  1056
           "contentMediaType": "text/markdown"
        },
                                                                                  1058
        "descriptionDetails": {
           "description": "Extended description of the state that
                                                                                  1060
supplements the description (valid markdown).",
                                                                                  1061
           "comment": "Accepts object for multilingual support.",
                                                                                  1062
           "$ref": "#/definitions/localizedString",
           "contentMediaType": "text/markdown"
                                                                                  1064
        },
                                                                                  1065
         "descriptionUrl": {
                                                                                  1066
           "description": "Hyperlink or resource to more information on
                                                                                  1067
the state.",
                                                                                  1068
           "comment": "Accepts object for multilingual support.",
                                                                                  1069
           "$ref": "#/definitions/localizedUrl"
                                                                                  1070
        },
                                                                                  1071
         "min": {
                                                                                  1072
           "description": "Lowest numerical value of the state (over all
                                                                                  1073
taxa).",
                                                                                  1074
           "comment": "Only to be used for numerical characters",
                                                                                  1075
           "type": "number"
        },
                                                                                  1077
        "max": {
                                                                                  1078
           "description": "Highest possible numerical value of the state
                                                                                  1079
(over all taxa).",
           "comment": "Only to be used for numerical characters",
                                                                                  1081
           "type": "number"
                                                                                  1082
        },
                                                                                  1083
         "stepSize": {
                                                                                  1084
           "description": "Step size of the state (steps between min and
                                                                                  1085
max, over all taxa).",
                                                                                  1086
```

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```
"comment": "Only to be used for numerical characters",
                                                                                    1087
           "type": "number"
                                                                                    1088
         },
                                                                                    1089
         "unit": {
                                                                                    1090
           "description": "Unit in which the state is measured or
                                                                                    1091
counted.",
                                                                                    1092
           "comment": "Only to be used for numerical characters. Accepts
                                                                                    1093
object for multilingual support.",
           "$ref": "#/definitions/localizedString",
                                                                                    1095
           "examples": [
                                                                                    1096
             "mm",
                                                                                    1097
              "meters below the surface",
              "spots",
                                                                                    1099
             "legs",
                                                                                    1100
              "kg"
                                                                                    1101
                                                                                    1102
         }
                                                                                    1103
      }
                                                                                    1104
    },
                                                                                    1105
    "statement": {
                                                                                    1106
       "description": "A fact connecting a taxon and a character through
                                                                                    1107
a certain value.",
                                                                                    1108
       "type": "object",
       "required": [
                                                                                    1110
         "id",
                                                                                    1111
         "taxonId",
                                                                                    1112
         "characterId",
                                                                                    1113
         "value",
                                                                                    1114
         "frequency"
      ],
                                                                                    1116
       "properties": {
         "id": {
                                                                                    1118
           "description": "Internally unique id of the statement.",
                                                                                    1119
           "$ref": "#/definitions/statementID"
                                                                                    1120
         },
                                                                                    1121
         "taxon": {
                                                                                    1122
           "description": "Id of the taxon this statement is about.",
                                                                                    1123
           "$ref": "#/definitions/taxonID"
                                                                                    1124
         },
                                                                                    1125
         "character": {
                                                                                    1126
           "description": "Id of the character this statement is
                                                                                    1127
about.",
           "$ref": "#/definitions/characterID"
                                                                                    1129
         },
                                                                                    1130
         "value": {
                                                                                    1131
           "description": "A value for this character for this taxon.
Must be either the id of a state, or an array of floats [min, max] for a
numerical range.",
           "oneOf": [
                                                                                    1135
                                                                                    1136
                "$ref": "#/definitions/stateID"
                                                                                    1137
             },
                                                                                    1138
```

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```
1139
                "type": "array",
                                                                                    1140
                "items": {
                                                                                    1141
                  "type": "number"
                                                                                    1142
               },
                                                                                    1143
                "minItems": 2,
                                                                                    1144
                "maxItems": 2
                                                                                    1145
             }
           ]
                                                                                    1147
         },
                                                                                    1148
         "frequency": {
                                                                                    1149
           "description": "The frequency with which the taxon has this
value for this character.",
                                                                                    1151
           "type": "number",
                                                                                    1152
           "minimum": 0,
                                                                                    1153
           "maximum": 1
                                                                                    1154
         },
                                                                                    1155
         "geography": {
                                                                                    1156
           "description": "The area(s) in which the taxon can have this
                                                                                    1157
property, represented as the coordinates array of a GeoJSON
                                                                                    1158
MultiPolygon.",
                                                                                    1159
           "$ref": "#/definitions/multiPolygon"
                                                                                    1160
         },
         "geographyService": {
                                                                                    1162
           "description": "An url or external service that returns
                                                                                    1163
distribution information for this property.",
                                                                                    1164
           "$ref": "#/definitions/url"
                                                                                    1165
         },
                                                                                    1166
         "media": {
                                                                                    1167
           "description": "Illustration(s) of this particular taxon
                                                                                    1168
having this particular property (this value for this character).",
                                                                                    1169
           "oneOf": [
                                                                                    1170
             {
                                                                                    1171
                "$ref": "#/definitions/mediaID"
                                                                                    1172
             },
                                                                                    1173
                                                                                    1174
                "type": "array",
                                                                                    1175
                "items": {
                                                                                    1176
                  "$ref": "#/definitions/mediaID"
                                                                                    1177
             }
                                                                                    1179
           ]
         },
                                                                                    1181
         "description": {
                                                                                    1182
           "description": "Short description of the taxon having this
                                                                                    1183
property (valid markdown).",
           "comment": "Accepts array for multilingual support.",
                                                                                    1185
           "$ref": "#/definitions/localizedString",
                                                                                    1186
           "contentMediaType": "text/markdown"
                                                                                    1187
         },
                                                                                    1188
         "descriptionDetails": {
                                                                                    1189
           "description": "Extended description of the taxon having this
                                                                                    1190
```

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```
property that supplements the description (valid markdown).",
                                                                                1191
           "comment": "Accepts array for multilingual support.",
                                                                                1192
           "$ref": "#/definitions/localizedString",
                                                                                1193
           "contentMediaType": "text/markdown"
        },
                                                                                1195
         "descriptionUrl": {
           "description": "Hyperlink or resource to more information on
                                                                                1197
the taxon having this property.",
           "comment": "Accepts array for multilingual support.",
                                                                                1199
           "$ref": "#/definitions/localizedUrl"
                                                                                1200
        }
                                                                                1201
      }
    }
                                                                                 1203
 }
                                                                                 1204
}
                                                                                 1205
                                                                                 1206
```

May 23, 2022 24/24